

THE
PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES.

(SECOND SERIES.)

VOL. X.

WITH FIFTY-EIGHT PLATES.

FOR THE YEAR 1895.

Sydney:

PRINTED AND PUBLISHED FOR THE SOCIETY

BY

F. CUNNINGHAME & CO., 146 PITT STREET,

AND

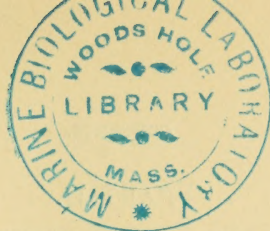
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PITT STREET.



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CORRIGENDA.

Page 78, in the last two lines—read *O. frenata* and *P. penicillata*.

Page 84, line 27—insert *m.*¹ between *mp.*⁴ and *m.*²

Page 85, line 15—*add* ; of the entire series of cheek teeth 98·5 (1).

Page 87, line 26—for premolars *read* the left premolar.

Page 88, line 4—for A second example, hinder portion, &c., *read* A second example—Hinder portion, &c.

Page 89, line 15—for *orcas* read *oreas*.

Page 93, line 4—after young *add* Cast of portion of a right maxilla with *m.*³ *m.*⁴ (10223) ; adult.

Page 94, line 5—The word but at the end of the line should have been omitted.

Page 99, lines 17, 29 and 31—for *P.*⁴ *read* in each case *P.*⁴

Page 100, line 2—for *P.*⁴ *read* *P.*⁴

Page 107, line 35—for lightly *read* slightly.

Page 467, line 18—for *Puccini pruni* read *Puccinia pruni*.



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PROCEEDINGS
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LINNEAN SOCIETY
OF
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WEDNESDAY, NOVEMBER 28TH, 1894, *Continued.*

ON A NEW SPECIES OF ENTEROPNEUSTA (*PTYCHODERA AUSTRALIENSIS*) FROM THE COAST
OF NEW SOUTH WALES.

By JAS. P. HILL, DEMONSTRATOR OF BIOLOGY, UNIVERSITY OF
SYDNEY.

(Plates I.-VIII.)

In a preliminary note communicated to this Society in September of last year I recorded the discovery of a species of Enteropneust at two widely separated localities on the coast of New South Wales, viz., at the ocean beach nearly opposite that part of Broken Bay known as Creel Bay, and also at Jervis Bay. Since the publication of the preliminary note I have found the same species on the beach nearly opposite Newport, N.S.W., and it may thus be looked for along the whole coast line of New South Wales. An examination of the form has shown that it is a new species belonging to the genus *Ptychodera*, and since it is the first

recorded from Australia, I propose for it the specific name *australiensis*.

The publication of Spengel's beautiful Monograph on the Enteropneusta* has rendered it unnecessary for me to enter into details of histology and the like, and also I do not propose, in this paper, to enter into the much discussed question of the affinities of the group. In the description, then, only points of specific difference are insisted on. I have adopted, generally, the terms proposed by Spengel, and my indebtedness to his monograph will be readily apparent from the sequel.

The species occurs in considerable abundance in a rocky corner of the ocean beach nearly opposite Creel Bay and a little to the south of the well known Hole in the Wall. Since the discovery of the species there in August of last year I have made two subsequent expeditions to the locality for further supplies of material, once in January and again in May of this year, and only on my last visit did I succeed in finding sexually mature individuals, so that the breeding season may, approximately, be given as the end of autumn.

During my visit to the locality I was very kindly accommodated by Mr. Chas. Hastie, of Creel Bay, and I must here take the opportunity of expressing my thanks to him for this kindness, and also to his family for much help in collecting specimens. Further, I must again acknowledge my indebtedness to Herr W. Musmann for much assistance with the literature.

MODE OF OCCURRENCE AND EXTERNAL CHARACTERS.

Like the other species of the genus *Ptychodera*, *Pt. australiensis* is littoral and confined to very shallow water. It is found, at low water, most abundantly in the loose gravelly sand at the bottom of the shallow pools, and especially in such sheltered situations as the gravelly sand under and around the large stones occupying the area included between high tide and half tide marks, very few specimens (if any) being found close to the low water mark.

* Fauna und Flora des Golfes von Neapel. xvii. Monographie: Enteropneusten, von Dr. J. W. Spengel.

The largest specimen found during my last collecting trip in May was a sexually mature male, measuring, in the living condition and when only very moderately extended, about 12 cm. in length with a breadth in the tail region of 7.25 mm. In August of last year, I found another large specimen which measured in the contracted condition about 18 cm. In the fully extended condition, this specimen, now in the teaching collection of the Biological Department of Sydney University, reached a length of over 25 cm. The majority of the animals were, however, very much shorter and thinner. They are capable of very considerable extension; for example, one specimen whose tail region had a transverse breadth of only 1.75 mm. reached in the fully extended condition a length of 11.7 cm.

Proboscis: The proboscis is relatively short like that of *Pt. minuta* and *Pt. sarniensis*. It varies in shape and length during life; when the animal is progressing it is more or less elongated, and when at rest generally somewhat egg-shaped, the latter being the shape it almost invariably takes when the animals are preserved in chrom-osmic acid. The proboscis of the first large specimen referred to above had a length of about 10 mm. in the living condition.

Collar: In the living animals the surface of the collar is smooth and in them, as well as in preserved specimens, it can readily be divided into the five characteristic regions (fig. 1). The first region includes slightly more than the anterior half of the collar, and is formed by the anterior free part of the latter. It spreads out anteriorly, investing the neck and base of the proboscis like a frill with margins crinkled as well during life as in preserved specimens. Behind the frill-like anterior region the collar is strongly contracted to form a well marked circular groove—the second region [figs. 1 and 15 (2)]—the anterior margin of which lies immediately above the mouth aperture. This groove is slightly more marked on the ventral side than on the dorsal.

The groove is followed by a prominent circular cushion of a lighter colour forming the third region [figs. 1 and 15 (3)]. Behind

this is found the typical ring furrow forming the fourth region [figs. 1 and 15 (4)], and this is separated from the trunk by a narrow projecting circular rim—the fifth region—which forms the posterior boundary of the collar, and is somewhat wider than the succeeding trunk section. The collar may reach a length of 9 mm. with a transverse breadth in the third region of 9 mm. also, so that in the living animal the collar may be said to be about as broad as long, but in preserved specimens the transverse breadth, owing to the strong contraction of the longitudinal collar musculature, considerably exceeds the length, and also the ventral length slightly exceeds the dorsal.

Trunk.

(1) *Branchiogenital Region*; This region may reach a length of from 36 to 40 mm. and a breadth of 7 mm. *Pt. australiensis* is especially characterised by the great development of the genital wings—the duplications of the dorso-lateral regions of the body in which the gonads are situated—and in this respect the species is to be associated with *Pt. aperta*, *clavigera*, *gigas*, and *aurantiaca*, in Spengel's provisional genus *Tauroglossus*. The anterior ends of the wings are continuous with the posterior rim of the collar, and immediately behind the latter their free edges may either slightly overlap each other or they may be infolded, and the wings then are in contact in the median line by their outer surfaces. The wings continue posteriorly in this condition and reach their maximum size somewhat posterior to the gill region. This condition is retained, in a slightly varying degree in different individuals, to within a short distance of the most anterior liver sacs, which are more or less completely hidden from view by the wings. Beyond this point the wings decrease rapidly in size and form two ridges lying at first laterally to the liver sacs but which are finally covered by the outer overhanging ends of the larger liver sacs (fig. 24, *gw.*), and which disappear altogether in the posterior part of the hepatic region.

When the wings have the position just described no part of the gill area is visible externally, and the most anterior small liver

sacs are also concealed from view. The gonads in sexually mature animals are found in the wings almost immediately behind the posterior rim of the collar, and they extend in the ridges far into the hepatic region. In sexually mature individuals the gonads may distend the genital wings to such a degree that they stand out almost horizontally to the body (fig. 23, *gv.*) and leave the gill area exposed, but the usual condition is the one first described where the gill area is completely concealed.

The gill area may reach a length of 15 mm., and is thus relatively very short. It is broadest just behind the collar, and narrows slightly posteriorly; laterally it is bounded by two longitudinal grooves which become gradually shallower posteriorly and terminate at the end of the gill area. Into these the gill pores open.

(2) *Hepatic Region*: varies in length according to the size and age of the animal. In one of my largest preserved specimens it measured over 20 mm. in length with about 50 liver sacs on each side. The number of sacs averages between 40 and 50 on each side, but there may be as many as 60. In fully extended animals the liver sacs present a distinctly paired arrangement in two longitudinal rows. They begin as small elevations in contact with each other, and covered by the genital wings; posteriorly they gradually increase in size, and attain their maximum development just beyond the point where the genital wings are reduced to ridges. Behind this the sacs gradually decrease in size to the posterior end of the region, finally being represented by two rows of small tubercles which become gradually reduced until they disappear altogether. Each sac arises by a narrow base which widens out into an antero-posteriorly compressed end, which in the region of the larger sacs overhangs the reduced genital wings. The form of the sac in this region is shown in fig. 24, *hep.*

Variation in Hepatic Region. The sacs are usually in close contact with each other by their anterior and posterior faces, but occasionally some of the cæca present the

appearance as if they were pressed out of position and overhang the sides of the body more than the others, giving the rows a slightly irregular appearance. I have also met with two specimens in which as a further result of displacement two rows of alternating sacs were formed on each side in the middle part of the hepatic region. Both these specimens had lost the whole of the body anterior to the liver sacs, and a new proboscis was in course of formation at the anterior end of the hepatic region. In a third specimen the sacs were normal in arrangement up to the larger sacs, but the succeeding sacs presented a very irregular appearance, forming two lateral masses, composed of irregularly arranged sacs, on either side of the dorsal median line, and not showing the alternation of the sacs seen in the other two specimens. It might be that this irregularity is the result of regeneration of the posterior part of the body.

(3) *Tail Region*: varies greatly in length in different individuals, but is usually about three times as long as the hepatic region. Its outline varies according as it is empty or full of sand; in the former case it is flattened, and in the latter more or less tubular.

The median dorsal line in preserved specimens is occupied by a dark ridge extending to the posterior end of the body, and marking the position of the dorsal nerve stem; on the ventral side the ventral nerve stem occupies the bottom of a shallow longitudinal groove. The tail region in this species is especially characterised by the presence of two dorsally situated longitudinal epidermal stripes (fig. 2) running parallel with the dorsal nerve stem and at a short distance from it. Appearing in the hepatic region just external to the posterior small liver sacs they extend over about the anterior two-thirds of the tail region, and are situated immediately above the ciliated grooves of the intestine. The epidermal stripes can be distinctly seen not only in preserved specimens but also in the living animal. Indeed, I observed and figured them in the latter before I knew of the existence of the two ciliated grooves in the intestine. The two epidermal stripes appear as two longitudinal interruptions of the island-like groups

of epidermal gland cells. The groups occupying the dorsal surface of the body extend between the upper margin of the epidermal stripe and the dorsal median line, while those occupying the ventro-lateral regions of the body terminate on its lower margin. According to Spengel, a similar epidermal stripe exists in *Pt. minuta*, but in correspondence with the single ciliated groove on the left side, only on that side, so that the presence of two epidermal stripes in *Pt. australiensis* may be taken as a character of specific value.

Behind the termination of the epidermal stripes the tail region becomes gradually somewhat narrower to its posterior end, in which is situated the terminal anus of varying outline.

Colouration: The sexually mature males and females can very easily be distinguished from each other by their different colouration. In both sexes the proboscis is of a light yellow colour, while the collar is of a slightly deeper yellow. In the males the testes are of a very deep yellow colour, or less frequently in some individuals of a deep orange. In the females the ovaries are of a very light yellow or almost whitish colour. The females are on the whole of a lighter colour than the males.

The most anterior liver sacs are of a brownish colour which passes posteriorly into slaty green, and this again into a deep brown in the region of the larger cæca, this brown colour being retained more or less completely in preserved specimens, while the other sacs lose their colour entirely. Posteriorly the sacs again assume a slaty green tinge. The tail region is whitish in colour and its walls transparent, readily allowing the sand particles in the intestine to show through.

This species is destitute of any odour. Incidentally it may be here mentioned that a large proportion of the individuals of this species are infested by a parasitic Copepod belonging to the genus *Ives* of Mayer,* but whether it is identical with the single member of the genus hitherto described, *Ives balanoglossi*, I am

* Ein neuer parasitischer Copepode. Mitth. Zool. Stn. Neap. Bd. i. p. 515.

as yet in doubt. The large female with its attendant small males is usually found in a very prominent tubular enlargement of a part of the free edge of one of the genital wings.

ANATOMY.

Proboscis: The epidermis of the proboscis (fig. 5, *ep.*) is somewhat thicker than in the case of *Pt. minuta* measuring .11 mm. It is separated from the underlying musculature by the limiting membrane, composed of two layers, the outer attached to the nerve fibre layer of the epidermis, the inner to the circular muscular layer. Between these two layers run the capillaries of the vascular net of the proboscis (fig. 5, *cnp.*). Below the limiting membrane is the thin layer of circular muscle fibres, also somewhat thicker than in the case of *Pt. minuta*, viz., .023 mm. The circular muscular layer gradually becomes thinner towards the neck of the proboscis, and finally thins out altogether. The delicate membrane limiting the circular muscular layer internally can readily be recognised especially in horizontal sections. On the inner side of the membrane, and at a little distance from it, there is an irregular cell layer, the nuclei of which are very distinct in hæmatoxylin preparations.

From the outer side of this limiting membrane there pass through the circular muscular layer numerous fine fibres to the inner layer of the limiting membrane of the proboscis, while on its inner side the fibres of the longitudinal musculature are inserted.

The fibres of the longitudinal musculature are related in their mode of origin from the proboscis base and in their course from there exactly as in *Pt. minuta*, and they show the same separation in preserved specimens into radial masses (fig. 5, *lm.*). The muscle fibres are embedded in a very fine connective tissue which anterior to the proboscis organs occupies the central region of the proboscis, muscle fibres being there absent. The connective tissue here presents a spongy appearance with a few very small nuclei situated in the course of the connecting strands or in the angles between the meshes. The splanchnic epithelium of the proboscis

cœlom (figs 4, 6, 7, 8, *sp.*) is related exactly as in the described species. It appears, in my preparations, when it comes to lie directly on the sides of the proboscis gut as a deeply staining layer with dark staining nuclei in its middle region (fig. 7, *sp.*), the cell bodies of which are not recognisable. On the surface of the glomerulus it presents essentially the same appearance of a deeply staining granular layer with numerous dark staining nuclei on its inner face (fig. 6, *sp.*).

On the outer side of the splanchnic epithelium there is a layer of tissue of a spongy appearance (figs. 6 and 7, *ct.*) which is directly continuous both above and below with the fine connective tissue of the proboscis cœlom (fig. 4, *ct.*). This layer corresponds to the characteristic layer described by Spengel* on the surface of the glomerulus in *Pt. sarniensis*, and which he considers as the inner limiting layer of the connective tissue of the proboscis. Round the central proboscis organs there is always in sections, as in the described species, a space free from connective tissue and representing the proboscis cœlom (figs. 5 and 8, *pbc.*). Posteriorly towards the proboscis neck the proboscis cœlom is divided, as in the other species, on the dorsal side through the heart bladder into two dorsal proboscis pockets (fig. 9, *dp.*), and on the ventral side through the ventral septum into two smaller ventral proboscis pockets (fig. 9, *vp.*). The ventral septum (figs. 3-5, 8, *vps.*) has in this species anterior and posterior free edges which run obliquely backwards, while its dorsal and ventral edges are attached to the proboscis gut and the outer wall of the proboscis respectively so that the septum is here four-sided and not triangular as in *Pt. minuta*. In its structure it is essentially similar to that of *Pt. minuta*. It consists of a central membrane carrying blood vessels, on either side of which there is a layer of muscle fibres—the ventral portion of the fibres of the dorso-ventral muscle plate; on the dorsal side, the fibres of the same plate can be distinctly recognised on the lateral walls of the heart bladder, below the splanchnic epithelium (figs. 3 and 5, *dsc.*).

* *Loc. cit.* p. 101.

The splanchnic epithelium continues on the surface of the ventral septum which, as Spengel has shown, represents a median fold of the ventral proboscis wall, and is connected at intervals with the limiting membrane of the epidermis. The two ventral proboscis pockets separated from each other by the ventral septum are usually filled by a loose connective tissue; however, in some cases, a distinct space bounded by this tissue may appear (fig. 12, *rp.*) Behind the posterior free edge of the septum the ventral pockets unite to form the ventral unpaired portion of the proboscis cœlom.

Exceptionally two folds may arise from the limiting membrane of the epidermis to form the proboscis septum; the two folds enclosing a median pocket between them unite with each other along the mid-ventral line of the proboscis gut. Further posteriorly the point of union of the two folds gradually passes ventrally until the median pocket is obliterated, and the septum assumes the normal condition. On the dorsal side the two proboscis pockets separated by the heart bladder are in different individuals of this species very varied in their relations. The proboscis pore may be single or double, and occupy a median position or it may be single and situated on the right side of the median line.

(*a*) In the majority of individuals the proboscis pore occupies a median position (fig. 12, *p.*) and it may then be formed in three ways—(1) The two dorsal proboscis pockets may unite with each other behind the heart bladder to form a single median proboscis canal which opens by the median proboscis pore; (2) the left pocket alone may form a proboscis canal, the right ending blindly; (3) the right pocket may form the canal, the left ending blindly.

(*b*) There may be two proboscis pores, the two dorsal pockets giving rise to two proboscis canals (fig. 10, *pc.*) which both open to the exterior (fig. 11, *p.*).

(*c*) The proboscis pore may be single and open on the right side; in this case the left pocket ends blindly while the right continues posteriorly, taking an almost median position above the

heart bladder to form the proboscis canal which opens on the right side.

With regard to the behaviour of the dorsal proboscis pockets, *Pt. australiensis* appears to be the most variable of all the Enteropneusts hitherto described.

Notochord (Eichel-darm of Spengel): In shape the notochord of this species essentially resembles that of *Pt. minuta*. Immediately anterior to the point of opening of the lumen of the notochord into the mouth or throat cavity, its narrow neck portion is dorso-ventrally compressed, with a convex dorsal wall and a concave thin ventral wall composed of a single layer of low columnar cells resting on the proboscis skeleton (fig. 16, *div.*). Anteriorly in the region of the proboscis neck the neck portion of the notochord is not so much dorso-ventrally compressed, but somewhat higher and with a more or less triangular lumen. The dorsal wall of the neck portion of the notochord is very much thicker than the ventral and is composed of long narrow epithelial cells which radiate outwards from the lumen and have central generally narrow rod-like nuclei. Between these elongated cells there occur numerous clear oval bladders which Spengel well regards as the secretory holders of gland cells. Some appear quite empty, others again show a network in their interior similar to that in the epidermal mucous glands and which stains in the same diffuse manner. They thus conform, as Spengel has shown, to the structure of the "goblet cells;" on the ventral side where the wall is composed of a single layer of columnar cells, these gland cells are entirely absent. The neck portion of the notochord is thus distinctly epithelial in character.

Anteriorly the dorsal wall increases considerably in thickness, while the cells of the ventral wall lose their distinctly columnar quality. They become longer and narrower, gland cells appear between them, and they finally pass over into the chorda-like tissue forming the wall of the ventral blind sac of the notochord. The lumen of the notochord extends obliquely downwards into the ventral blind sac (fig. 14), then in this the lumen extends



transversely outwards, reducing the lateral walls of the blind sac to a thin layer, while the hind and middle portions of the wall are somewhat thicker, as in *Pt. minuta*. From the transverse lumen of the blind sac there passes forwards laterally a short horn on each side (fig. 9, *lb.*); a section passing through the proboscis neck just anterior to the passing down of the ventral blind sac lumen thus shows three cavities in the notochord (fig. 9), two ventrolateral belonging to the horns of the ventral blind sac lumen and a median situated near to the dorsal side of the notochord, the main notochordal lumen now considerably reduced in size and with numerous gland cells opening into it. Anteriorly the lumen comes to occupy a more nearly central position (fig. 8, *div.*); it finally becomes reduced to a narrow slit (fig. 4, *div.*), which can be traced to a slightly varying distance from the apex of the notochord (fig. 14, *div.*). The lumen varies somewhat in position and shape in different individuals, being in some situated nearer the dorsal side, in others nearer the ventral side of the notochord; its outline also varies—it may be circular or form a narrow vertical or horizontal cleft. The lumen in this species has on the whole a more median position than in *Pt. minuta*, and consequently the dorsal and ventral walls are more nearly equal in thickness. In fig. 14 the lumen of the notochord is represented somewhat diagrammatically as a continuous wide canal, but as in *Pt. minuta* it is interrupted by occasional bridges of tissue, and also as in that species the dorsal wall of the lumen is smooth, while into the ventral there project short processes of the lumen (fig. 14, *div.*). With the exception of the anterior part of the lumen numerous gland cells open into it, testifying to the epithelial nature of the whole structure. Numerous gland cells exist in the dorsal wall of the neck portion of the notochord and they extend for a considerable distance into the head region, being specially abundant round the part of the lumen situated just anterior to the point of origin of the ventral blind sac lumen. The lumen is, in some preparations, almost filled up by a diffusely staining network, apparently derived from the secretion of the gland cells opening into it. Numerous elongated cells, between

which the gland cells are situated, radiate outwards from the lumen. They have elongated, rod-like nuclei situated at about their middle region, and on the dorsal side their outer ends come into connection with processes from an irregular layer with rounded nuclei situated immediately below the limiting membrane of the notochord. On the ventral side the passing over of these distinct epithelial cells into the chorda-like tissue can be distinctly recognised (figs. 9 and 12, *dv.*).

In correspondence with the widely diverging legs of the proboscis skeleton the opening of the proboscis gut lumen into the mouth cavity, at first narrow, becomes eventually a very wide transverse opening, in the anterior part of the mouth cavity. I have also encountered in the proboscis gut the yellow granules which Spengel regards as excretions.

Proboscis Skeleton: it consists, as in the described species, of a main body, a keel-like ventral portion, and two posterior diverging legs (fig. 13). The anterior portion of the body is formed by the funnel-like "end plate" which invests the ventro-lateral regions of the ventral blind sac of the notochord. The lateral edges of this plate extend somewhat in front of the ventral, so that they appear first in sections as two thin plates investing the lateral faces of the blind sac (fig. 9, *eps.*). The anterior "end plate" gradually narrows posteriorly, its dorsal edges unite with each other in the median line, and it passes into the body proper. By the union of the dorsal edges of the "end plate" there is sometimes formed a blind canal continuing for a short distance into the body proper, and occupied by a prolongation of the "chorda-like tissue" of the hind wall of the ventral blind sac. The "keel" first appears at a short distance behind the anterior edge of the "end plate" in the form of a small V-shaped structure with widely divaricated legs. It is separated from the end plate by a thin band of "chondroid tissue." Then gradually the ventral apex of the keel thickens and gives rise to a distinct ventrally projecting tooth-like portion, the keel now having in section the form of a Y (fig. 10, *kps.*). The "body" has at first a semilunar outline, with the flat side immediately

adjoining the ventral wall of the neck of the notochord and the curved side above the divaricated legs of the Y-shaped "keel." At this point there passes in the "chondroid tissue" between the "body" and "keel" a vessel connecting the two efferent proboscis vessels (fig. 10, *cv.*) Immediately behind this vessel the "body" becomes triangular in outline and its apex gradually approaches and finally fuses with the median portion of the "keel" between its divaricated legs which now give rise to two lateral "wings." Anterior to and at the point of fusion the body is much stouter than the keel, the "wings" of the latter only projecting a very little beyond the lateral surfaces of the body, but posterior to this the body gradually decreases in breadth and also in height, while the keel thickens greatly, forming in transverse sections much the bigger half of the whole structure. The "wings" of the "keel" at the same time reach a greater lateral extension and form two distinct lateral projections below the middle region of the body when the entire skeleton is viewed from above (fig. 13). Posteriorly the wings become gradually smaller and finally disappear, while the body becomes reduced to a narrow somewhat convex plate separated from the keel by two small vertical half moon-shaped masses with their convex faces touching each other. These are the first indications of the two "legs," and for them Spengel adopts Bateson's term "nuclei." After the first appearance of the "nuclei" the keel gradually becomes reduced in size, the "nuclei" at the same time becoming larger and more distinct. The place where the "nuclei" first touch in the middle line corresponds, as Spengel has shown, to the most anterior point the opening of the notochordal lumen into the mouth cavity has occupied. In transverse section the proboscis skeleton has, just after the proboscis neck has fused with the collar, a triangular shape, but gradually as the "keel" is reduced in size and the "nuclei" become larger and more distinct, the shape becomes quadrangular and the skeleton then consists of a dorsal plate, representing a continuation of the "body" and derived from the notochord, a middle portion formed by the two semilunar "nuclei" derived from the throat epithelium, and a ventral plate

thicker in the middle—the continuation of the “keel”—derived also from the throat epithelium as the opening of the notochordal lumen gradually moved posteriorly (fig. 16, *lps*’.). Towards the posterior end of the skeleton the “keel” disappears entirely, the two “nuclei” separate from each other ventrally, and the epithelium of the throat extends up into the cleft between them. The continuation of the body lying above the nuclei then thins out, and the “nuclei” separate completely from each other, giving rise to the “legs” proper which lie under a fold of the throat epithelium. The “legs” may pass out at once almost transversely, or they may diverge more gradually in different individuals. They terminate considerably in front of the middle region of the collar.

The proboscis skeleton is composed of a cuticular substance which shows in this species a very distinct stratification, indicating the mode of origin of the mass by the deposition of successive layers, and the direction of these layers indicates very clearly from what source they are derived. As Spengel has shown, the “end plate” is derived from the ventral blind sac of the notochord, while the “body” is derived from the neck of the same. The “keel” on the other hand is formed from the epidermis of the proboscis neck, and its posterior continuation from the epithelium of the throat.

In this species the “end plate” and the anterior portion of the “body” are separated from the keel by chondroid tissue, and the direction of the lines of stratification in these parts indicates clearly enough their distinct origin. The relations of the skeleton to the limiting membranes are essentially those of the described species. The body passes over at its edges into the limiting membrane of the notochord, while the wings of the keel pass over into that of the epidermis.

In the proboscis skeleton of this species there occur a few small oval cells with non-staining cell bodies and deeply staining small nuclei. They are situated between the layers of stratification. Such cells occur in the proboscis skeleton of *Pt. clavigera*, *gigas* and *aurantiaca*, and with Spengel I believe they are cells

which have become enclosed during the formation of the skeleton, and not cells which have immigrated later.

“*Chondroid tissue*”: As in the genus *Ptychodera* generally the “chondroid tissue” of the proboscis neck is not greatly developed, and the cell strands appearing generally in transverse sections as small isolated masses are derived as Spengel has shown mainly from the epithelium of the proboscis pockets. As in *Pt. clavigera* a band of “chondroid tissue” continuous with the lateral tissue is present between the “end plate” and “keel” of the proboscis skeleton. The cell strands of this ventral portion are very richly developed, and are derived from the epithelial cells lining the ventral proboscis pockets and behind the posterior edge of the proboscis septum from the continuation of the same epithelial cells lining the ventral unpaired portion of the proboscis coelom.

Heart-bladder: The heart-bladder is essentially similar in its general relations to that of *Pt. minuta*. It is a completely closed sac, having no connection either with the vascular system or with the proboscis coelom. On its lateral walls the muscle fibres belonging to the dorso-ventral muscle plate are very well marked (fig. 5, *dsc.*), but as in the other species of the genus they do not possess a musculature of their own. On the ventral wall there is present as in the described species a very distinct single layer of transverse muscle fibres which, so far as I have observed, are entirely confined to this wall. In this species the ventral wall of the heart-bladder is infolded into the cavity of the bladder in a very characteristic manner. In its posterior part the central blood space of the proboscis is a transverse cleft between the ventral wall of the heart-bladder and the proboscis gut just as in the species previously described, and varies in size according as it is filled with blood or empty. In its anterior region, however, the ventral wall of the heart-bladder is infolded into the cavity of the bladder along the median line so as to give rise to a tubular cavity which communicates with the central blood space by a narrow longitudinal slit (fig. 4, *ivv.*). Then posteriorly to the infolding by the gradual receding of the two edges of the slit, the

tubular cavity merges gradually into that of the central blood space. Anteriorly, however, the anterior end of the tubular infolding projects towards the end of the heart-bladder as a short free blind sac which extends into the cavity of the heart-bladder beyond the anterior end of the longitudinal slit placing the tubular cavity in communication with the proper cavity of the central blood space. Consequently in a series of transverse section this free end first appears as an apparently isolated cavity with muscular walls lying in the cavity of the heart-bladder and quite independent of its ventral wall (fig. 3, *inv.*).

The only parallel for this condition in other Enteropneusts appears to exist in *Balanoglossus canadensis*, which, according to Spengel, possesses a similar infolding of the heart-bladder wall, although it is still more complicated in other respects.

According to Spengel the ventral wall of the heart-bladder serves to furnish the central blood space with the musculature by whose contraction the blood is forced out of the central blood space into the sinuses of the glomerulus, and thence into the efferent proboscis vessels. We have therefore to regard this infolding of the ventral heart-bladder wall into a tube free anteriorly, inasmuch as it increases the power of that wall, as a special modification to ensure the better performance of its propelling function. I have found this condition so frequently in this species that it may be taken as a character of specific value.

In the interior of the heart-bladder a space exists in its greater extent (figs. 3, 4, 5 and 14, *h*), but at its anterior and posterior ends the cavity is obliterated by a cellular tissue. Anteriorly this tissue has the appearance of a spongy connective tissue with numerous nuclei in its connecting strands, and I have not been able to observe in this any distinction into two portions, one derived from the dorsal, the other from the ventral wall, such as Spengel describes for *Pt. minuta*. An irregular cavity appears in the dorsal part of this mass, a short distance behind the anterior end of the heart-bladder, and the loose tissue below it gradually becomes reduced in size passing into an irregular layer of endothelial cells on the ventral wall of the heart-bladder. These

cells do not form in this species, so far as I have observed, a definite layer, but are irregularly disposed (figs. 4 and 5), and very frequently some of them are of an elongated form with one end attached to the heart-bladder wall. The portion of the anterior cell mass above the cavity continues as a narrow strand occupying the apex of the cavity of the heart-bladder, and limited from it by a very tender membrane (fig. 5). This dorsal strand of tissue passes on either side into the flattened endothelium which lines the lateral walls of the heart-bladder. The rounded nuclei of this endothelium can be readily recognised, placed at fairly regular intervals from each other, but the cell bodies are not distinct in my preparations. As the heart-bladder decreases in size posteriorly the cells of the dorsal strand unite with processes from the irregular endothelial cells of the ventral wall, and eventually the posterior part of the cavity is filled up as in *Pt. minuta* by a mass of tissue denser than that of the anterior end (fig. 9, *h.*), and through which there pass between the lateral walls of the heart-bladder fine transverse fibres which Spengel regards as muscular.

Yellow granules may sometimes be observed in the cellular tissue in the heart-bladder.

Glomerulus : The glomerulus will be dealt with in connection with the vascular system, and I need only mention here one point in connection with it. Lying on the splanchnic epithelium and internal to it between the glomerulus vessels I have observed, in some individuals of this species though not in all the series I have examined, some bundles of parallel muscular fibres (fig. 6, *glm.*). They very often have the appearance of being inserted into the tender membrane forming the walls of the vessels of the net at the periphery of the glomerulus. The fibres also frequently project beyond the outer surface of the splanchnic epithelium, and readily give one the impression that they were during life continuous with similar bundles which lie at the inner edges of the radial masses bounding the space surrounding the proboscis organs, and from which they are separated only by a very narrow interval. These muscular fibres in the glomerulus of this species

appear to correspond to the fibres Spengel has observed in *Balanoglossus canadensis* and *B. kuppferi*, and which he regards as having been carried in, by the infolding of the splanchnic epithelium.

Collar: The epidermis of the collar can, like that of the other species of *Ptychodera*, be divided into five zones (fig. 15 [1-5]). Of these the first formed by the anterior free rim of the collar is the largest; the second occupies the region of the circular groove; the third, that of the circular projecting cushion; the fourth, the bottom of the typical ring furrow; while the fifth is formed by the narrow projecting rim forming the posterior boundary of the collar. The second and fourth zones are similarly constituted; they stain darkly with hæmatoxylin, and as in *Pt. minuta* they contain in their whole depth numerous gland cells; the remaining zones contain gland cells only in their outer regions, and stain of a lighter colour.

Collar musculature: It is in this species in its general relations essentially similar to that of *Pt. minuta*.

In the outer wall of the anterior part of the collar there is the usual external layer of longitudinal muscle fibres (figs. 14, 16, *lfw.*) which spring in the posterior part of the collar between the longitudinal muscle bundles of the inner wall. Internal to these there is the layer of circular fibres which terminate at the beginning of the second epidermal zone (figs. 14, 16, *cfw.*). The longitudinal muscles of the inner wall of the collar springing from the region of the collar trunk-septum are, as in *Pt. minuta*, separated in the posterior part of the collar into distinct bundles by radial fibres passing between the outer and inner walls of the collar. The ventro-lateral bundles terminate behind the circular vessel fold of the collar, while those more dorsally situated pass towards the neck of the proboscis, and are inserted, as in *Pt. minuta*, mainly into the boundary membrane of the notochord (fig. 16, *ilm.*; fig. 11, *ccp.*). The dorsal portion of the longitudinal musculature extends, in the posterior region of the collar, round the lateral surfaces of the perihæmal spaces, and partly on to the dorsal

surface of the collar cord. Anterior to the circular vessel fold there occurs a fairly thick band of muscle fibres which arise from the sides of the proboscis skeleton, and surround the mouth aperture circularly, and from this layer there pass up the longitudinal fibres of the fore wall of the collar (fig. 14, *ifw.*). The radial fibres passing between the fore and outer walls of the anterior margin of the collar have the usual intercrossing arrangement (fig. 14, *rf.*).

The extensions of the trunk cœlom into the collar—the perihæmal and peripharyngeal spaces—are related essentially as in the known species of *Ptychodera*. As in *Pt. sarniensis* and *aperta*, the perihæmal spaces, with the exception of their anterior portions which are situated entirely below the collar cord (fig. 16, *phs.*), enclose between them a groove in which the ventral two-thirds of the collar cord is situated (figs. 17 and 18, *phs.*). The greater portion of their cavities is occupied by the longitudinal musculature of the dorsal wall, which is inserted anteriorly in greater part into the boundary membrane of the epidermis behind the proboscis canal. On the ventral wall of each space there is a single layer of longitudinal fibres, while between dorsal and ventral walls there pass radial fibres. The peripharyngeal space (figs. 17, 18, *pps.*) is related exactly as in *Pt. minuta*. As in that species, there pass across the circular fibres which it contains numerous connecting strands between its inner and outer limiting membranes. Anteriorly it terminates on the dorsal side about on a level with the opening of the notochordal lumen into the throat (fig. 14, *pps.*), while ventro-laterally it terminates along the point of origin of the circular vessel fold.

Collar Cœlom. In the anterior part of the collar the spongy connective tissue containing radial muscle fibres fills up the cœlom almost completely, but posteriorly where the fibres are arranged in the form of radial strands there remain between adjacent strands spaces free from connective tissue just as in *Pt. minuta* (fig. 18, *cœ*). Ventrally a longitudinal space exists, into which the ventral vessel fold projects, and on the dorsal side, just

anterior to the internal openings of the collar canals, two distinct spaces exist.

With regard to the division of the collar cœlom into two halves, considerable variation exists in this species. Dorsal and ventral septa may be entirely absent, the two side halves of the cœlom then standing, as in *Balanoglossus kupfferi* according to Spengel, in open communication.

The dorsal septum when present differs from the normal condition in *Pt. minuta* with regard to its relation to the "roots." In that species, according to Spengel, the dorsal septum only exists in the posterior part of the collar; two "roots" are situated anterior to it, and its anterior free edge always appears to correspond to one of the "roots." In this species the septum may arise in the anterior region of the collar and in front of the most anterior root as a fold projecting from the dorsal surface of the collar cord and with a free anterior edge, and which reaches the outer wall where the first "root" fuses with the collar epidermis. The septum then passes between the remaining "roots" to the posterior end of the collar. Over part of its course it may be interrupted: the ventral connection with the dorsal surface of the cord is lost, the septum at the point of interruption appearing as a free fold projecting from the inner surface of the outer collar wall. Further, in other individuals the front edge of the septum may coincide with either the first or the second "root."

As to the ventral septum (fig. 19, *vcs.*) when present, it exists only in the most posterior part of the collar and there only for a very short distance. It may be present when the dorsal is absent. In fig. 18 a section passing just anterior to the ventral septum is represented. The vessel fold (*s/v.*) arising from the subepidermic collar capillaries exists only for a short distance in the posterior region of the collar, and is not always so distinct as in the series from which this section is taken; posteriorly it unites with one of the longitudinal vessel folds to give rise to the ventral septum (fig. 19, *vcs.*). The collar canals and the collar-trunk septum are related in this species exactly as in *Pt. minuta*.

Nerve Cord of Collar: The collar nerve cord (figs. 16, 17, 18, *cnc.*) varies in shape in transverse sections in different individuals and in different parts of the same individual, from band-shaped to almost circular. In its general features the cord of this species agrees with that of *Pt. minuta* as described by Spengel. An axial canal is not present in the cellular part of the cord, and the "cord hollows" are not so numerous as in that species. Two lateral longitudinal rows of "cord hollows" exist, while smaller, less regularly arranged hollows may be present in the central region. The entire number of hollows appearing in one section is seldom greater than four. These "cord hollows" are related to each other exactly as in *Pt. minuta*.

I have never observed an anterior insinking of the epidermis into the cellular part of the cord to form an anterior epidermal pocket, but a very short and narrow epidermal pocket may exist at the posterior end of the cord.

As in all other known species of the genus, the fibrous layer of the cord completely surrounds the cellular portion.

With regard to the histology of the cellular part of the cord, I have never been able to observe in any of my preparations the giant ganglion cells described and figured by Spengel. I can clearly distinguish, however, large granular nuclei, rounded or oval in form, and with distinct nucleoli, which belong probably to what Spengel regards as the proper nerve cells. They occur especially above the ventral portion of the nerve fibre layer and also in the middle region of the cord and below the thin dorsal portion of the fibre layer. Round these nuclei there may sometimes be seen an ill-defined little staining cell body, apparently branching.

The "stalked cells," with their elongated, deeply staining, narrow nuclei can also be readily distinguished. They radiate outwards from the thin cuticular lining of the "cord hollows," and their fibre-like ends penetrate the nerve fibre layer. Also there occur throughout the cellular part of the cord, but especially above the ventral portion of the nerve fibre layer, numerous deeply staining rounded nuclei, with ill-defined cell bodies.

In the nerve fibre layer, below the cellular part of the cord, nuclei are found, with small oval non-staining cell bodies which are produced at either end into fibre-like processes. Clear oval spaces also occur in the fibrous layer, but I have not been able to convince myself that these form continuous tubes, and they never possess any protoplasmic remains in their interior such as Spengel describes for the processes passing into the fibrous layer from the giant ganglion cells. These spaces appear to be simply lacunæ between the ramifying fibres composing the fibrous layer.

Roots : In this species the most anterior "root" may arise from the anterior region, *i.e.*, in front of the middle point of the collar cord, contrary to Spengel's statement that the roots always spring from its middle or posterior end. Generally, however, the first root is situated about the middle region of the cord. The roots vary in number from one to four, the latter number being the usual one. In one series five roots arose from the collar cord, but I was unable to find the dorsal point of union of the fifth with the epidermis. As in the described species, the roots vary greatly in direction; sometimes they pass straight between the collar cord and the epidermis, but generally they take an oblique course, forwards or backwards, to their point of union with the epidermis. In one series the first two roots fused with each other midway between the collar cord and epidermis, while in another series two of the roots arose from the collar cord by a short common stem. Each root consists as in the described species of an outer limiting membrane carrying blood vessels, and continuous at the one end with the limiting membrane of the dorsal cord, at the other with the limiting membrane of the epidermis. Internal to this is a thin fibre layer continuous ventrally with the nerve fibre layer of the collar cord. The interior of the root presents a varying appearance at different parts; in some sections, and especially in those of the first root, a distinct central cavity may exist limited by a delicate membrane from which processes radiate outwards. These processes apparently belong to cells, the nuclei of which are situated just internal to the fibrous layer, the whole structure recalling the appearance of the stalked cells radiating

from the "cord hollows." I have never been able to trace these hollows in the roots as continuous canals throughout the whole length of even the first "root," and am convinced that in none of the "roots" of this species does a continuous canal exist such as Spengel describes for the first "roots" in *Pt. minuta*, *clavigera*, *aperta*, and *bahamensis*. Similar though smaller hollows may exist in the "roots" succeeding the first, but just as in the first "root" the hollows do not stand in continuous connection, but are interrupted by anastomosing strands or in some cases by branching cells with large nuclei. I have likewise never observed the "collar hollows" to pass into the roots.

The roots end dorsally just as Spengel describes (fig. 16, *rt.*). The outer limiting membrane and the fibrous layer of the root unite with the similar layers of the epidermis; while the cellular tissue of the root projects in a cone-like mass between the epidermal cells, the apex of the cone reaching to within a short distance from the outer surface. The apex of this cone-like mass of tissue is composed of a network of fine strands enclosing clear spaces, and with a few very small nuclei in the angles where the strands meet. Below this clear tissue and continuous with it, there occur more deeply staining branched cells which are directly continuous with the central tissue of the "roots."

Nerve Stems of Trunk: These are related exactly as in the described species, and the circular commissure placing the fibrous layer of the collar cord in connection with that of the ventral stem can be readily seen in horizontal sections occupying the deep groove between collar and trunk. The cells covering the circular fibre ring are entirely destitute of gland cells, and consequently are sharply marked off from the adjacent epidermal cells.

The dorsal stem in the branchial region is situated somewhat below the level of the adjacent epidermis (fig. 20, *dnv.*), but posterior to this region it forms a distinct ridge. The ventral stem, on the other hand, occupies over its whole extent the bottom of a shallow longitudinal groove (figs. 20, 24, *vn.*). The fibrous layer of the dorsal stem is, as in *Pt. minuta*, somewhat triangular in transverse section; it is thickest in the middle, and laterally

tapers off gradually into the fibrous layer of the epidermis. That of the ventral stem is more band-like in form, and laterally passes over suddenly into the epidermic fibrous layer. In the cellular portion of the dorsal stem gland cells are comparatively few in number, while they are altogether wanting in the ventral. Of the two stems the ventral is the more strongly developed, and towards the posterior end of the body it remains more distinct than the dorsal.

In my preparations, and especially in the ventral cord, the "stalked cells" of Spengel can readily be distinguished. They are elongated fibre-like cells with generally long deeply staining nuclei. These cells are specially developed at the lateral margins of the ventral stem. Their fibre-like basal processes traverse the fibrous layer, while their outer ends converge towards the middle line of the stem, thus enclosing a central space largely occupied by the nerve cells. The nuclei of these latter are easily distinguishable by their large size and rounded appearance; they do not stain very deeply, possess distinct nucleoli, and exactly resemble the nuclei of the nerve cells in the collar cord. The nerve cells lie immediately adjacent to the fibrous layer, and this fibrous layer as well of the collar cord as of the trunk nerve stems is to be regarded, according to Spengel, as made up of the ramified and interlaced processes of these nerve cells. Here, as in the collar cord, I have never succeeded in observing the giant ganglion cells.

Trunk.

(1) *Branchial region*: As in all known species of *Ptychodera* there is below the epidermis a delicate layer of circular muscle fibres, in this species only a single fibre in thickness. The longitudinal musculature internal to this is strongly developed and as in the described species is interrupted dorsally and ventrally by the vessel stems. The longitudinal musculature of the outer wall of the genital wings is considerably stronger than that of the inner wall. The latter is interrupted in the region of the sub-median lines in whose course the openings of the ducts of the gonads are situated. Numerous radial fibres

pass from the limiting membrane of the epidermis through the muscular layers to be inserted into the ventro-lateral portions of the walls of the œsophagus and into the lateral regions of the gill pockets. Laterad of the œsophagus a free space is left as in the described species, and this contains in sections a coagulated fluid in which cells are embedded. The two halves of the trunk cœlom are completely separated from each other ventrally by the ventral vessel which extends between the limiting membrane of the epidermis and that of the gut. On the dorsal side the dorsal vessel may occupy the whole height of the mesentery or only its dorsal half.

Gut Canal of Branchial region: As in all the known species of the genus *Ptychodera* the gut canal in this region is separated into two passages—a dorsal or branchial canal (fig. 20, *gg.*) and a ventral or œsophagus (fig. 20, *œ.*). They communicate with each other by a narrower or wider cleft according as the two limiting cushions (fig. 20, *lc.*) are approximated to or remote from each other. Except for the much greater development of the genital wings in this species, a transverse section through its branchial region (fig. 20) agrees almost exactly with a similar section of *Pt. minuta*. The gill skeleton is composed of three-pronged forks which are related just as in *Pt. minuta*; the number of “Synaptikels” (fig. 20, *sn.*) varies from seven to ten.

The epibranchial stripe forming the median dorsal boundary of the branchial canal is composed of numerous relatively very long and narrow cells; and its middle region does not stain so deeply as the lateral regions in which gland cells are situated. The lateral regions pass over opposite the “gill tongues” into the high epithelium (fig. 21, *gtb.*) of the “tongue back” (the inner wall of the tongue next the gut canal). The gland cells are specially abundant in the middle region of the epithelium of the “tongue back,” and not placed nearer its front face as in *Pt. minuta*. This epithelium passes over into the narrow strand of “intermediate epithelium” (fig. 21, *ies.*) composed of small non-ciliated cells which furnishes the low epithelial covering of the “Synaptikels.” The lateral walls of the tongue and of the gill pocket are lined

by a layer of columnar cells with long cilia just as in the described species, and the "tongue floor" composed of cells poor in protoplasm is also, as in them, infolded into the cavity of the "tongue." This cavity (fig. 21, *gtc.*) just as in *Pt. minuta* is lined by an irregular peritoneal layer, and also contains fibres which stretch across between its opposite walls at a short distance below the "tongue back."

The gill pores (fig. 20, *gp.*) are narrow slits slightly obliquely placed, which open into the longitudinal grooves bounding the "gill area" laterally, and as in the described species the longitudinal muscles lying laterally to the pores give off fine bundles which pass between adjacent pores to join the longitudinal muscles on the inner side of the gill pores.

The anterior ends of the gill rows project for some distance into the posterior region of the throat (fig. 18, *ag.*), but owing to the oblique direction of the most anterior gills the posterior rim of the collar forming the so-called "operculum" of Bateson covers at most only the first gill pore. The conditions are essentially the same as in *Pt. clarigera* since the genital wings do not possess free anterior edges, but are united with the hind edges of the collar, thus enclosing between them and the "gill area" the space for which Spengel adopts the term "atrium." It is into the narrow anterior projection of this space below the posterior edge of the collar that the first gill pore opens.

The number of gills varies according to the age of the animal, since new ones are being continually formed during life at the hind end of the gill region. As in *Pt. minuta* the number of gills never appears to exceed 40 pairs, but in the majority of individuals the number is very much less than this. The gill gut is not closed blindly behind as in *Pt. minuta*, but passes directly over into the gut of the succeeding genital region.

(2) *Post-branchial region*.—*Genital region*: The musculature and the dorsal and ventral vessel stems are essentially related as in the branchial region. The wall of the gut (fig. 23, *i.*) in this region is usually folded, and lies at a varying distance, usually small, from the longitudinal musculature, and there pass

from its ventro-lateral region to the limiting membrane of the epidermis numerous radial fibres. The trunk cœlom represented in the branchial region by the spaces situated laterally to the œsophagus is here considerably reduced and represented by irregular spaces.

The lateral septa (figs. 22, 23, *ls.*) are related essentially as in the described *Ptychodera* species. In the middle of the genital region the septa are of considerable breadth, and pass between the dorsal corner of the gut and the submedian line, which is here situated at about the middle of the internal face of each of the genital wings (fig. 23, *ls.*). Anteriorly the point of attachment of the septum to the gut gradually passes medianly (fig. 22, *ls.*) until at the level of the last developing gill pocket it passes over to the skin, to which it is then attached at both ends. In the branchial region the ventral point of attachment of the septum gradually approaches the lateral, which always remains at the submedian line until the two unite. Posteriorly to the middle of the genital region the submedian line gradually passes down from the mid-region of the inner face of the genital wing, and takes a position close to its base, and at the same time the septa are reduced gradually in breadth and finally end with a free edge in the anterior portion of the hepatic region. The lateral septa thus separate off from the main trunk cœlom two dorsal chambers which anteriorly end blindly in the posterior part of the branchial region, while posteriorly they communicate with the main trunk cœlom by their narrow openings. These dorsal chambers Spengel regards as blind-sac-like outgrowths of the trunk cœlom arising in the anterior part of the hepatic region.

Gonads: The gonads begin in the "genital wings" immediately behind the posterior rim of the collar and continue for a considerable distance into the hepatic region. As distinguished from *Pt. minuta*, in which the gonads are simple unbranched sacs, they are in this species, in correspondence with the greatly developed "genital wings," much branched, and are here more complexly branched than is usually the case in *Pt. clavigera*. As in these species, only primary gonads and primary genital pores exist. In

the branchial region, as is characteristic of the genus *Ptychodera*, the gonads only exist laterally to the gill pores, and consist of dorsal and ventral gonad branches which are each again subdivided into lesser lobes: the dorsal usually into two long lobes which occupy the uppermost portion of the cavity of the genital wings, the ventral into a number (3-4) of shorter and smaller lobes.

In the genital region proper, as in *Pt. clavigera*, each gonad consists of three main branches: (1) a dorsal (figs. 22, 23, *dgb.*) occupying, as in the branchial region, the dorsal part of the cavity of the "genital wings," and divided into two long lobes or in some cases into two long lobes and one short one; (2) a ventro-lateral branch situated on the outer side of the lateral septum, between it and the outer body wall, and also subdivided into two lesser lobes (figs. 22, 23, *vglb.*); (3) a median lateral branch occupying the cavity of the dorsal chamber of the trunk coelom, enclosed by the lateral septum and extending in it above the gut towards the median dorsal line (figs. 22, 23, *mg.*). This median ventral branch is also subdivided into two. In this species, then, there are in connection with each genital pore at least six lesser branches. In fig. 23, a section from about the middle of the genital region is represented which has passed through one of the genital pores (*gap.*) filled up by a mass of spermatozoa. The specimen from a series of which this section is taken was preserved while in the act of extruding the ripe spermatozoa in the form of whitish filmy masses.

Structure of Gonads: According to Spengel the wall of the gonads consists of three layers—an outer peritoneal layer, a middle limiting membrane and an inner germ layer. The outer peritoneal layer is in my preparations very indistinct, and represented by some small flattened nucleated cells more or less remote from each other and closely applied to the middle limiting membrane. In the latter there is situated a well marked blood sinus. I have never been able to observe a layer of longitudinal muscles in the wall of the gonads in this species. Also, I have not been able to distinguish the germ layer as a distinct layer, but certain small

rounded cells lying irregularly internal to the limiting membrane in young gonads doubtless belong to it. In the young gonads there is present a distinct central cavity filled up in some cases by a deeply staining homogeneous substance. As in the other species of *Ptychodera*, the gonads contain large numbers of rounded or cubical masses of a peculiar substance which in the sexually immature animals fills up the gonads almost completely. It is found in the young gonads, both male and female, but it persists for a much longer time in the case of the ovaries than in the testes. Even in the mature ovaries traces of it remain, while in the mature testes no trace of it is left. Spengel regards this substance as nutritive in function, and the presence of the abundant deutoplasm in the ova readily accounts for its greater persistence in the ovaries.

The ova of this species are essentially similar to those of *Pt. minuta*. They average about $\frac{1}{10}$ mm. in diameter, and possess very abundant granular deutoplasm. The germinal vesicle is very large, and contains a spongy nucleoplasm in which there is situated one large nucleolus and several smaller masses. The ripe ovum is invested in a thick egg membrane attached to which there may be a few very small flattened nuclei apparently representing the follicular layer. The heads of the ripe spermatozoa are somewhat ovoid or rounded in form, and the flagellum is very long and slender (fig. 26).

Hepatic region: With the exception of the presence of two ciliated bands in the gut, Spengel's description of this region in *Pt. minuta* applies generally to that of this species. The liver sacs (fig. 24, *hep.*) communicate with the gut by narrow transverse clefts bounded by anterior and posterior lips. The wall of the gut is thrown into obliquely transverse folds which are interrupted on the dorsal side by the two longitudinal grooves, while a well marked furrow occupies the median dorsal region of the gut.

The liver sacs are lined by a layer of close-set long narrow cells with long nuclei in a row near their base (fig. 24, *hep.*). The cells contain numerous yellowish-brown granules, which also occur less abundantly in the somewhat shorter but otherwise similar

cells lining the gut. The cells of the liver gut possess distinct cilia, and in accurate sections through its lining epithelium which are met but seldom, the outer surfaces of the cells form a sinuous line, and no vacuoles are visible in them, so that, as Spengel remarks, the vesicles he has observed in them are probably the result of the action of reagents. On the outer side of the epithelium of the liver sacs and the gut wall there is a rich system of capillary vessels. As in other species of *Ptychodera*, except *Pt. minuta* and *sarniensis*, two ciliated grooves are present in this species, and they show the usual structure. Each consists of a special ciliated band of long columnar cells sunk below the level of the gut epithelium and bounded on its dorsal or median side by a projecting conical mass composed of elongated cells, the "covering pad."

The ciliated grooves extend for a considerable distance into the genital region proper, and they are there situated somewhat below the points of attachment of the lateral septa to the gut wall, and are separated from the epidermis by the thick layer of longitudinal musculature. Posteriorly, about the middle of the hepatic region where the liver sacs are largest, the genital wings are reduced to mere ridges, overhung by the outwardly extended ends of the liver sacs. In fig. 24, the left half of a section about the middle of the hepatic region is represented, and the ciliated groove (*cgr.*) is seen to lie just below the outer wall of the reduced genital wing (*gw.*) and now quite close to the epidermis, being separated from it only by a thin layer of the longitudinal musculature which becomes thinner just at this point. The genital wings can be traced as mere elevations of the epidermis below which the ciliated grooves are situated to near the posterior end of the hepatic region.

Hind Body: The course of the ciliated grooves behind the hepatic region is marked externally by two longitudinal epidermal stripes which, commencing laterally to the posterior small liver sacs, extend over the anterior two-thirds of the hind-body region. The hind body can thus be divided into an anterior abdominal region characterised by the presence of the two epidermal stripes

and the underlying ciliated grooves, and into a posterior caudal region.

In the abdominal region the ciliated grooves may be situated directly under the epidermal stripes or may be remote from it by a short distance, but always the portion of the longitudinal musculature between them is somewhat thinner than elsewhere. The cells of the epidermal stripes usually stain darker, and are somewhat lower than the adjacent cells, and in one case where the groove was situated immediately under the epidermal stripe there existed what appeared to be a special differentiation of the cells of the latter in the form of a small mass of cells with rounded nuclei and distinct nucleoli. In other respects the abdominal region of this species closely agrees with that of *Pt. minuta*. The wall of the gut in this region (fig. 25, *i.*) is thrown into numerous somewhat irregular transverse folds, and it becomes further removed from the longitudinal musculature so that the cœlom is very much more distinct than in the liver region and, as there, divided into two distinct halves only, however, in the anterior part of the region. The band-like cellular mass which Spengel has found in *Pt. minuta* and *sarniensis* in connection with the dorsal vessel and lying along the dorsal median line of the gut also exists in this species. It has here the form of a low band of cells of varying height lying as in the described species between the two lamellæ of the boundary membrane of the gut and not limited laterally. Between the dorsal vessel and the cellular mass there passes a short mesentery, and by the separation of this into two lamellæ the cavity of the dorsal vessel comes into direct connection with the cellular mass. At these points the cells of the mass are not closely packed, and have a branching character exactly like the endothelial cells of the dorsal vessel with which they seem to be continuous.

The caudal region of the hind body is essentially similar to that of *Pt. minuta*. As in the posterior part of the abdominal region, the two halves of the cœlom here stand in connection below the dorsal vessel. On the ventral side the ventral vessel disappears as a distinct structure at the beginning of this region, while the

dorsal vessel retains its lumen to near the posterior end of the body.

As Spengel has found in *Pt. minuta*, the place of the ventral vessel is taken by the keel-shaped process of the gut epithelium. As in *Pt. minuta*, a very delicate musculature is found on the gut in this region, and as in that species a distinct sphincter derived from the circular musculature exists round the anus.

Vascular System.—*Dorsal vessel*: In the post-branchial region the dorsal vessel is related essentially as in *Pt. minuta*. It can be traced as a vessel with a distinct lumen to near the posterior end of the body; it appears, however, to end as a solid structure at its extreme posterior end just as in *Pt. minuta*. In the branchial region the dorsal vessel may occupy the whole of the mesentery or only its dorsal portion. Between the perihæmal spaces the dorsal vessel usually occupies the whole extent of the partition wall, but just as in *Pt. minuta* it may only occupy the dorsal half of it, and the ventral part of the wall may then either persist as a low wall of partition below the vessel, or it may disappear entirely and place the two perihæmal spaces in communication.

At the anterior end of the perihæmal spaces, the dorsal vessel opens, as in the described species, into a lacuna (figs. 11, 12, 14, *cl.*) between the organs in the proboscis neck and which stands in connection with the central blood space of the proboscis by a narrow cleft. From the lacuna there passes away dorsally a vessel (fig. 10, *oar.*), the afferent skin vessel, which Spengel regards as carrying blood to the capillary net of the proboscis. Where two proboscis canals are present it passes between them (fig. 10); where there is only one canal, along one side of that. It then passes into the limiting membrane and runs in that anteriorly for a short distance, finally dividing as in the described species into two branches which divide up again to form the capillary net of the proboscis.

Proboscis glomerulus: The glomerulus of this species essentially resembles that of *Pt. minuta*. It covers the anterior ends of the

heart bladder and the proboscis gut, but just behind the anterior ends of these it becomes limited to two lateral masses lying on the heart bladder and the notochord, and to a small median portion on the dorsal side of the heart bladder. This median portion which stands in connection with the lateral portions by vessels on the walls of the heart bladder posteriorly gives rise to two or three large longitudinal vessels which finally unite to form one main vessel (fig. 3, *mgl.*) which passes obliquely backwards and upwards along the dorsal edge of the heart bladder (fig. 5, *esv.*), and comes into connection with the capillary net of the proboscis. Ventrally, also, the lateral masses stand in connection with the capillary net by a network of vessels in the ventral septum of the proboscis. According to Spengel, these vessels, dorsal and ventral, probably act as the efferent skin vessels, *i.e.*, they probably convey the blood from the capillary net of the proboscis to the glomerulus. The glomerulus vessels themselves are similar in their relations to those of *Pt. minuta*. As Spengel has shown, these vessels represent a honeycomb-like system. As in that species corresponding to the floor of the honeycomb there is a sinus on the lateral walls of the heart bladder which communicates with the central blood space by narrow clefts. From the sinus there radiate outwards vessels which, in longitudinal vertical sections, are readily seen to be connected in a net-like manner, and at the periphery of the glomerulus they give rise to a network of much larger vessels (figs. 3, 4, 5, 6, *gl.*). The latter opens into a longitudinal vessel occupying the ventral corner of each half of the glomerulus, and which in this species can be traced to near the anterior end of each half of the glomerulus (figs. 3, 4, 5, *epv.*). These vessels Spengel terms the efferent proboscis vessels, and according to him they arise at the posterior end of the glomerulus. In this species they certainly become distinct at the posterior end of the glomerulus (fig. 8, *epv.*), but they can be followed up from here as distinct vessels lying in the ventral corner of each half of the glomerulus to near its anterior end.

From a comparative study of the glomerulus, and from its histology, Spengel is led to regard the glomerulus as a system of

infoldings of the splanchnic epithelium, the spaces between these infoldings being filled with blood and representing the glomerulus vessels. For this view speaks the arrangement of the nuclei which occur more or less regularly along the course of the vessels. Round the nuclei an oval non-staining cell body can frequently be recognised, and they can in some places, as Spengel has observed, pass directly over into the splanchnic epithelium.

Efferent Proboscis Vessels: The efferent proboscis vessels after they leave the glomerulus are essentially similar in their course and disposition to those of *Pt. minuta*. However, as Koehler* has found in *Pt. sarniensis*, the two efferent proboscis vessels are connected with each other in the proboscis neck by a well-marked vessel (figs. 10, 14, *cv.*) which passes, in the "chondroid tissue" occupying the space between the anterior portion of the "keel" of the proboscis skeleton and the posterior portion of the "end plate." I have met this connecting vessel not only in transverse series, but also in both vertical and horizontal longitudinal series, and there can, in my opinion, be no doubt as to its existence in this species. Spengel, however, asserts that the efferent proboscis vessels "never stand in connection with each other," and believes "Koehler has been apparently deceived through the intense colouration with carmine of certain parts of the skeleton which thereby become very similar to the blood fluid."† A series of transverse sections through an individual of the species under consideration, whose vessels were richly filled with coagulated blood, leaves me in no doubt on the matter, and the appearance presented by the vessel as seen in two adjacent sections is represented in fig. 10 (*cv.*). The specimen was stained with cochineal in 70% alcohol with the result that the coagulated blood stained a much deeper tint than the proboscis skeleton, allowing the two to be very easily distinguished, and moreover the coagulated blood in the connecting vessel could be distinctly seen to pass over at both ends into that in the efferent proboscis

* Contribution à l' étude des Entéropneustes Internat. Monatsschrift f. Anat. u. Histologie, Bd. iii. 1886, p. 174

† *Loc. cit.*, p. 633.

vessels. Further, the "keel" and "body" of the proboscis skeleton are at this point quite distinct from each other and separated by the narrow ventral band of "chondroid tissue," and there is certainly no median prolongation anteriorly from the point of fusion of the "body" and "keel" of the proboscis skeleton which takes place just behind the connecting vessel, and which could be mistaken for the vessel in question.

We may then take it as characteristic of *Pt. australiensis*, at least, that the efferent proboscis vessels are united by a connecting vessel passing in the "chondroid tissue" between the "body" and "keel" of the proboscis skeleton.

Further, in this species the capillary net of the proboscis comes directly into connection with the efferent proboscis vessels in the proboscis neck, and indeed anteriorly to the connecting vessel. In sections through the proboscis neck, in the region of the ventral blind sac, vessels are found in the here commencing "chondroid tissue" which, as Spengel has shown, is simply the thickened limiting membrane of this region into which cellular strands derived mainly from the proboscis pockets have penetrated. Some of these vessels enter the efferent proboscis vessels (fig. 9), and they thus serve to place the capillary net of the proboscis directly in connection with the efferent proboscis vessels, while the dorsal and ventral efferent skin vessels, since they return the blood first to the glomerulus, do so indirectly.

Vessels of Collar: The efferent proboscis vessels are continued into the collar, and are related there essentially as in the described species of *Ptychodera*. They appear on their entrance into the collar as clefts in the limiting membrane on either side of the proboscis skeleton, and have at first a longitudinal direction. Very soon they diverge outwards in a fold of the limiting membrane and finally pass downwards round the mouth cavity in a fold of the limiting membrane of the inner wall of the collar—the circular vessel fold. Their dorsal portions are formed of single vessels (fig. 16, *cvc.*) which ventro-laterally give rise to two capillary nets (fig. 17, *cvc'.*) which unite in the mid-ventral line of the anterior part of the collar to form the longitudinal ventral

vessels of the collar, formed by folds of the outer limiting membrane of the peripharyngeal space.

The circular vessels stand in direct connection as in the described species with the capillary net in the outer limiting membrane of the peripharyngeal space, and also anterior to the line of termination of the latter with the capillary vessels below the epithelium immediately surrounding the mouth aperture.

The ventral longitudinal vessels generally consist in this species of two distinct folds which may be secondarily branched (fig. 18, *lvc.*). The longitudinal vessels may, however, be represented by a single simple or much branched fold, or of three or four distinct folds.

As in the described species the ventral longitudinal vessel folds open at their posterior ends into a lacuna in the collar-trunk septum, into which the circular vessel passing in the septum immediately below the circular nerve ring opens laterally, and from which the ventral longitudinal vessel of the trunk takes its origin.

Capillary System of Collar is related essentially as in the described species. On the dorsal side, the vessels in the limiting membranes of the "roots" placing the outer and inner capillary nets in connection are strongly developed (fig. 15). Ventrally, in the hind half of the collar by the formation of a longitudinal fold of the limiting membrane of the epidermis, a median longitudinal subepidermic vessel (fig. 18, *slv.*) may in some cases be formed opposite the ventral longitudinal plexus. Posteriorly, the former fuses with one of the folds of the latter, and the capillary net of the inner collar wall is thus brought on the ventral side into direct connection with that of the outer. In some individuals, however, the ventral mesentery may be entirely absent, and no such connection established.

The capillary net surrounding the dorsal cord is in this species strongly developed, and especially on its dorsal side (figs. 15 and 17) well-marked vessels (fig. 17) pass off, from the dorsal side of the dorsal vessel, in the limiting membrane between the perihæmal spaces and the collar cord. These laterally pass upwards in the

limiting membrane of the collar cord to form the capillary net on its dorsal surface, and branches also pass downwards in the boundary membrane laterally to the perihæmal spaces and come into direct connection with the capillary net of the inner wall of the collar. Very few vessels leave the ventral side of the dorsal vessel in this species, and the capillary net of the inner wall of the collar thus appears to stand mainly in connection with vessels derived from the dorsal side of the dorsal vessel, in common with the capillary net of the collar cord.

Ventral Vessel of Trunk: The ventral vessel is related exactly as in *Pt. minuta*. It does not extend so far posteriorly as the dorsal, but disappears at the point of origin of the keel-shaped process of the gut.

Lateral Vessels: The lateral vessels are essentially similar to those of the described species. In the branchial region they occupy the usual position just below the submedian lines (fig. 20, *llv.*). Then when the lateral septa appear, they run in these (fig. 22, *llv.*). Towards the ends of the septa the vessels gradually pass downwards towards the point of attachment of the septa to the gut, and then behind the termination of the septa they continue as free vessels lying in the interior of the now greatly reduced genital wings (fig. 24, *llv.*) and which finally about the middle of the hepatic region pass over into the gut capillaries. In this part of their course the vessels possess, as in the other species, circular muscle fibres in their walls, and also from the latter there radiate outwards fine fibres (fig. 24, *llv.*), probably functioning as expanders.

Gill Vessels: My observations on this very complicated set of vessels confirm, so far as they go, those of Spengel. The afferent gill vessels arising from the dorsal vessel vary according as the dorsal vessel occupies the whole of the mesentery or only its dorsal half. In the former case the afferent vessels pass off directly from the ventral side of the dorsal vessel; in the latter they diverge outwards and downwards from its ventral side, the mesentery being apparently absent at this point. The afferent

vessels arise from the dorsal vessel opposite the gill tongues. Each, according to Spengel, divides soon after its origin into two vessels—one of which passes into the tongue and divides again to form the two vessels running along the tongue prongs, the other passes to the gill septum in front of the tongue which received the first vessel, and probably becomes continuous with the septal vessel. I have not been able to make out from my preparations the above described connections to my complete satisfaction. Each of the afferent vessels seems to stand in connection with a vessel lying just above the line of attachment of the gill tongue, and this vessel extends on to the dorsal edge of the succeeding septum, and is situated just above the dorsal end of the gill skeleton. Through this vessel there is doubtless established the connection between the blood flowing in the gill tongues and that in the septa.

The vessels in the tongue are exactly as described by Spengel. In transverse sections through the branchial region the capillary net in the tongue situated immediately below the peritoneal covering of the tongue cavity (fig. 20, *cut.*) can be distinctly seen, and especially in horizontal sections the larger vessels of the net, viz., the large vessel situated immediately under the epithelium of the “tongue back” and the two smaller vessels along the inner side of each tongue prong (fig. 21, *tp.*) can be distinctly recognised (fig. 21). In each of the gill septa the septal vessels (figs. 20, 21, *ngs.*) can readily be made out running just external to the septal prong (*spr.*). At their ventral ends the septal vessels stand in connection with the “limiting vessel” below the boundary cushion between the branchial canal and the œsophagus, and this “limiting vessel” stands in the usual connection with the capillary net on the wall of the œsophagus.

Though none of my preparations show a distinct capillary net in the gill septa, in some I have observed small branches passing from the septal vessel, and these probably represent part of the capillary net Spengel has found so richly developed in the gill septa of *Pt. sarniensis*.

EXPLANATION OF PLATES.

Reference Letters.

ag. Projections of the anterior ends of the gill rows into the throat.
av. Afferent skin vessels of proboscis. *bps.* Body of proboscis skeleton.
bv. Limiting vessel of branchial region. *cbs.* Central blood space of proboscis. *ccp.* Prolongations of collar cœlom into the proboscis neck. *cfw.* Circular musculature of outer wall of anterior rim of collar. *cyr.* Ciliated groove. *ch.* "Chondroid tissue." *civ.* Capillary net of inner wall of collar.
cl. Cleft into which dorsal vessel opens. *cm.* Circular musculature of proboscis. *cnc.* Collar cord. *cnp.* Capillary net of proboscis. *cnt.* Capillary net of gill tongue. *cœ.* Collar cœlom. *cœ'.* Parts of collar cœlom into which collar pores open. *cp.* Covering pad. *ct.* Inner layer of connective tissue of proboscis on the splanchnic epithelium. *cv.* Vessel connecting the two efferent proboscis vessels in the proboscis neck. *cvc.* Dorsal portion of circular vessel fold of collar. *cvc'.* Ventral plexus of circular vessel fold of collar. *dgb.* Dorsal gonad branches. *div.* Notochord.
dn. Dorsal nerve stem of trunk. *dp.* Dorsal proboscis pockets. *dsc.* Fibres of dorso-ventral muscle plate. *dv.* Dorsal vessel of trunk. *ehcp.* Epithelium of liver sac. *ep.* Epidermis. *epb.* Epibranchial strand. *eps.* "End plate" of proboscis skeleton. *epth.* Epithelium of throat. *epr.* Efferent proboscis vessels. *esv.* Efferent proboscis skin vessels on front edge of heart bladder. *g.* Gonads. *gap.* Genital aperture. *gc.* Gill cleft.
gg. Branchial canal. *gl.* Glomerulus. *glm.* Muscle fibres of glomerulus. *gp.* Gill pore. *gs.* Gill septum. *gt.* Gill tongue. *gtb.* Epithelium of gill tongue back. *gtc.* Gill tongue cavity. *gv.* Genital wings. *h.* Heart bladder. *hep.* Cavity of liver sac. *i.* Intestine. *ies.* Intermediate epithelial stripe of gill tongue. *ifw.* Musculature of fore wall of anterior rim of collar.
ilm. Inner longitudinal musculature of collar. *ilm'.* Portion of same passing to the proboscis base. *ivw.* Infolding of ventral wall of heart bladder. *ivw'.* Anterior projection of the same into the cavity of heart bladder. *kps.* "Keel" of proboscis skeleton. *lb.* Anterior horn of blind sac lumen. *lbs.* Ventral blind sac of notochord. *lc.* Limiting cushions between branchial canal and œsophagus. *lfw.* Longitudinal musculature of outer wall of anterior rim of collar. *llv.* Lateral longitudinal vessel. *lm.* Longitudinal musculature of proboscis. *lmt.* Longitudinal musculature of trunk. *lmv.* Longitudinal musculature of ventral wall of perihæmal spaces. *lps.* "Legs" of proboscis skeleton. *lps'.* "Nuclei" of proboscis skeleton.
ls. Lateral septa of trunk. *lvc.* Longitudinal ventral vessel folds of inner wall of collar. *mg.* Median gonad branches. *mgl.* Vessel passing from the median dorsal portion of the glomerulus. *nf.* Nerve fibre layer. *nrg.* Nerve fibre ring of proboscis neck. *oav.* Dorsal prolongation of the blood cleft in proboscis neck to form the afferent skin vessels. *œ.* Œsophagus.

ol. Opening of lumen of notochord into the throat. *p.* Proboscis pore.
pbc. Proboscis cavity. *pc.* Proboscis canal. *phs.* Perihæmal spaces. *pps.*
 Peripharyngeal space. *rf.* Radial fibres passing between the outer and
 fore walls of anterior rim of collar. *rt.* "Roots." *scn.* Subepidermic
 capillary net of collar. *slv.* Median longitudinal vessel of the subepidermic
 capillary net in the posterior ventral part of the collar. *sn.* "Synaptikel."
sp. Splanchnic epithelium of proboscis cœlom. *spr.* Septal prong of gill
 skeleton. *thh.* Throat or mouth cavity. *tpr.* Tongue prongs of gill skeleton.
trc. Trunk cœlom. *ves.* Ventral collar septum. *vgb.* Ventral gonad
 branches. *vgs.* Septal vessel. *vn.* Ventral nerve stem. *vp.* Ventral pro-
 boscis pockets. *vps.* Ventral septum of proboscis. *vv.* Ventral vessel of
 trunk. *vw.* Ventral wall of heart bladder.

 PTYCHODERA AUSTRALIENSIS.

Plate I.

- Fig. 1.—Enlarged dorsal view of a small preserved specimen.
 Fig. 2.—Dorsal view of a portion of the abdominal region showing the two
 epidermal stripes. ($\times 3$.)
 Fig. 3.—Central part of a transverse section of the proboscis passing
 through the anterior free projection of the infolded ventral
 wall of the heart bladder. Zeiss A., oc. 1., cam. luc.
 Fig. 4.—Transverse section slightly posterior to fig. 3, but from another
 series especially showing the infolding of the ventral heart
 bladder wall. Zeiss A., oc. 1., cam. luc.

Plate II.

- Fig. 5.—Transverse section passing through about the middle region of
 the proboscis organs. Zeiss A., oc. 1., cam. luc.
 Fig. 6.—Portion of glomerulus in transverse section. Zeiss D., oc. 1.,
 cam. luc.
 Fig. 7.—Transverse section of the splanchnic epithelium on the notochord.
 Zeiss D., oc. 1., cam. luc.

Plate III.

- Fig. 8.—Transverse section through the beginning of the proboscis neck.
 Zeiss A., oc. 1., cam. luc.
 Fig. 9.—Transverse section of proboscis neck posterior to fig. 8 and pass-
 ing through the ventral blind sac of the notochord. Zeiss A.,
 oc. 1., cam. luc.
 Fig. 10.—Transverse section of proboscis neck passing through the pro-
 boscis canals and the connecting vessel between the efferent
 proboscis vessels. Zeiss A., oc. 2., cam. luc.

Plate IV.

- Fig. 11.—Transverse section of proboscis neck of an individual with two proboscis pores. Zeiss A., oc. 2., cam. luc.
- Fig. 12.—Similar section of an individual with a single median proboscis pore. Zeiss A., oc. 2., cam. luc.
- Fig. 13.—Dorsal view of proboscis skeleton. ($\times$ about 30).
- Fig. 14.—Vertical longitudinal section (nearly median) through the point of union of the proboscis neck with the collar. Zeiss A (without lowest lens), oc. 1., cam. luc.

Plate V.

- Fig. 15.—Vertical longitudinal section through the dorsal region of collar Zeiss A., oc. 1., cam. luc.
- Fig. 16.—Dorsal median portion of a transverse section through the anterior region of collar. Zeiss A., oc. 1., cam. luc.

Plate VI.

- Fig. 17.—Transverse section through the collar passing through the opening of the notochord into the throat and through the circular vessel fold. Zeiss A (without lowest lens), oc. 1., cam. luc.
- Fig. 18.—Transverse section through the posterior region of collar. Zeiss A (without lowest lens), oc. 1., cam. luc.

Plate VII.

- Fig. 19.—Transverse section of ventral part of collar slightly posterior to fig. 18, showing the ventral septum. Zeiss A., oc. 1., cam. luc.
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- Fig. 22.—Transverse section of a sexually immature individual, just behind the branchial region. Zeiss A (without lowest lens), oc. 1., cam. luc.

Plate VIII.

- Fig. 23.—Transverse section through the genital region of a sexually mature male, passing through a genital pore. Zeiss A (without lowest lens), oc. 1., cam. luc.
- Fig. 24.—Transverse section through the hepatic region. Zeiss A., oc. 1., cam. luc.
- Fig. 25.—Transverse section through the abdominal region showing the two ciliated bands. Zeiss A., oc. 1., cam. luc.
- Fig. 26.—Ripe spermatozoa. Zeiss D., oc. 4., cam. luc.

ON A PLATYPUS EMBRYO FROM THE INTRA-UTERINE EGG.

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(Plates IX.-XIII.)

Introduction.

The following paper is based on the examination of two embryos taken from the intra-uterine eggs of a Platypus. Beyond the facts that Monotremes are oviparous and the ovum is meroblastic the material collected by Caldwell in 1884 has afforded us very little information, and we have thought that a description of a Platypus embryo of this stage may not be unwelcome to zoologists. In this paper we necessarily confine ourselves to a description of the structure of the embryo lying before us. Next year, now that we know the exact breeding season of Platypus in certain convenient localities in New South Wales, we shall endeavour to obtain the stages intermediate between the earliest we now possess and the embryo described in this paper.

The female from the left uterus of which the two eggs were taken was shot on 1st October of this year. The general external characters of the egg have already been sufficiently accurately described.* The eggs were both exactly of the same size and spheroidal in shape. The egg shell is, as Caldwell described, of an opaque white colour and quite soft, presenting a general resemblance to the shell of a lizard's egg.

The eggs measured 18 mm. in their long and 13·5 mm. in their short diameter. They are thus somewhat larger than the eggs secured by Caldwell, who gives the measurements of the egg when

* Caldwell, Phil. Trans. 1887, p. 473.

laid as 15 mm. by 12 mm. Three other females were shot on the same date, and these had obviously just laid their eggs, as evidenced by the emptiness and large size of the left uterus and by the presence and condition of corpora lutea in the ovary. Moreover, the mammary glands in all four females were of approximately the same size. The tubules were arranged in a fan-like fashion, radiating outwards from the, at this stage, very small bare area of the ventral abdominal wall, and measured 5 cm. in length.

From the size of these eggs as compared with Caldwell's, and from the condition of the other three females shot on the same date, we may reasonably conclude that they were just ready to be laid.

The only other recorded measurements besides Caldwell's of the size of the Platypus eggs when laid are contained in a paper by Geoffroy St. Hilaire published in 1829.* The eggs, nine in number, were found lying on a rough nest in a small burrow on the banks of the River Hawkesbury, N.S.W., and measured $1\frac{3}{8}$ inches (34 mm.) long by $\frac{6}{8}$ of an inch (19 mm.) broad. The eggs here described were probably not those of Platypus at all: as St. Hilaire himself afterwards pointed out, they could not on account of their size pass through the pelvis, and he then came to the conclusion that in Platypus the eggs must be hatched inside!

The eggs were opened immediately after the animal was shot and their contents preserved in picro-sulphuric acid. The embryos were stained with borax-carmin, imbedded in paraffin and cut into serial sections with the Cambridge microtome.

To our friend, Prof. J. T. Wilson, we are indebted not only for many valuable suggestions but for much kindly criticism during the course of our work, and we desire here to tender him our sincere thanks. We have also to thank Messrs. Shewen and Grant, assistants in the Physiological Laboratory, for much assistance in the preparation of the photo-micrograph accompanying this paper.

* Ann. des Sc. Nat. T. xviii. p. 162.

General Description of the Embryo as seen in Surface View.

On opening the egg, the embryo was found lying on the surface of a thin-walled vesicle, with its long axis corresponding to the long diameter of the egg. It extended over the surface of the vesicle almost from pole to pole. The vesicle completely filled the interior of the shell. It contained a thin whitish transparent fluid of an albuminous nature which was precipitated in picrosulphuric acid. Immediately below the wall of the vesicle there appeared a thin layer of yolk granules which was somewhat increased over a small area at the ant-embryonic pole. The embryo measured 19 mm. from the anterior end of the medullary plate to the extreme posterior end of the primitive streak. This hinder point of measurement is 1.5 mm. behind the blastopore. A photo-micrograph of the embryo from the dorsal side magnified $5\frac{1}{3}$ diameters is shown in Pl. ix. Outside the elongated and somewhat fiddle-shaped contour of the embryo is seen a lighter more transparent zone (Pl. ix. *am. a.*) corresponding to the amniotic area of other mammals. In the fresh condition no trace of a vascular area was visible, though in the hardened blastoderm developing vessels were indicated by a mottling both in and around the amniotic area. Immediately in front of the anterior end of the embryo there was to be seen a lighter area—the proamnion—(Pl. ix., *pra.*) into which the mesoderm had not yet extended. The antero-lateral portions of the embryo were almost entirely occupied by two sharply limited patches situated one on either side of the anterior region of the medullary plate, opposite the position of the future first and second cerebral vesicles. The outer contours of these head plates are posteriorly in line with the forward continuations of the outer borders of the proto-vertebral zones of mesoderm. The outer margins of these head plates mark the lateral limits of a very considerable mesodermal thickening in this region, and we may for convenience of description term them the head plates of mesoderm. Their relations to the general mesoderm will be described later.

The commencing separation of the embryo from the vesicle is indicated by the presence of a sulcus, the so-called head-fold, which

passes back for a distance of approximately .17 mm. below the anterior end of the medullary plate and thus separates the latter from the underlying proamnion. This sulcus we must suppose has arisen as in other forms by the forward growth of the anterior end of the medullary plate over this bilaminar portion of the blastoderm.

Lateral and tail folds are not yet developed.

The medullary plate is still flat with the exception that along its mesial line a definite groove (the "Rückenfurche") is developed. Medullary folds are absent throughout except in the region of the future fore-brain.

In the head region the three future cerebral vesicles are indicated by widenings of the medullary plate. The first is separated from the second by a well marked constriction, while a less marked constriction situated somewhat anterior to the posterior margins of the mesodermal head plates separates the second from the third.

The upgrowths of the medullary folds in the lateral regions of the fore-brain are very apparent in the photo-micrograph as two dark lines (Pl. ix., *md.f.*). The continuation of these lines across the front of the medullary plate is produced by the thickening and duplication of the medullary plate at the head fold (Pl. xi., figs. 15 and 16 *cp.*).

The medullary plate in the region of the hind-brain is especially characterised by the presence on each side of four oblong metamERICALLY arranged opaque masses extending from the outer edges of the medullary plate to within a short distance of the mesial line. These, as will be shown later, are local thickenings of the medullary plate, and are therefore true neuromeres. The neuromeres are arranged in bilaterally symmetrical pairs, and adjacent ones are separated from each other by well marked transverse constrictions. The first pair (Pl. ix., *n.*) are situated entirely in front of the auditory plates. They are narrow and transversely elongated. The second pair are not so distinct, and do not extend quite so far mesially as the first. The third pair are very distinct and somewhat broader than the first. They are directed slightly

backwards. The fourth pair are much less distinct than the others, and in surface view are not so sharply limited from the medullary plate.

In the anterior region of the mid-brain, a pair of neuromeres (Pl. ix., N.) occur, but they are much less distinct than those of the hind-brain, appearing merely as local thickenings of the medullary plate in that region, without any accompanying constrictions.

Opposite the second and third neuromeres of the hind-brain there is on each side a somewhat triangular thickened patch of ectoderm—the auditory plate (Pl. ix., *aud.*). The mesoderm in the region of the auditory plates is very thin, hence they stand out very distinctly. The anterior margin of each plate is on a level with the front edge of the second neuromere; indeed the greater portion of the plate is situated opposite this neuromere. Each plate is roughly triangular in shape, with the base of the triangle adjoining the medullary plate, and with a deep bay in the middle of its posterior margin.

The hind-brain region narrows gradually posteriorly and passes into the medullary plate of the future spinal cord. The medullary plate widens out towards the posterior end of the embryo into a well marked sinus rhomboidalis which completely surrounds the primitive streak. The primitive streak is just visible in the photo-micrograph (Pl. ix., *pr. s.*) as a faint linear thickening enclosing a whitish axial line—the primitive groove—at the posterior end of the embryo. The anterior end of the primitive streak exhibits a distinct thickening, to one side of which the blastopore (Pl. ix., *bl.*) is situated. This thickening is continued forwards as the head process of the mesoderm which passes into the hinder end of the notochord. The notochord is very distinct in the photo-micrograph as the longitudinal line running along the middle of the medullary plate. At its anterior end it broadens out, and terminates about the middle of the future fore-brain.

The bilateral Anlagen of the heart are very noticeable in surface view (Pl. ix., *h.a.*) as two tubular-looking structures lying external to the auditory plates, and extending backwards from them along the outer edges of the forward extensions of the lateral zones of

mesoderm, nearly up to the first somite. They are thus situated in greater part opposite the hind-brain region.

In the trunk region, on either side of and extending below the medullary plate there are seventeen pairs of somites: the first pair situated relatively far back with regard to the auditory plates, and separated by a considerable space from the last neuromere. The anterior somites are square in shape with their borders at right angles to the axial line. They become successively broader and shorter towards the posterior end of the embryo, where they are placed obliquely to its long axis.

On each side just external to the outer edges of the somites (with the exception of the first three) and between them and the lateral zone of mesoderm there occurs a narrow intermediate zone containing the Anlage of the Wolffian body (Pl. ix., *w.b.*). Beginning as a faint line opposite the fourth somite, it becomes more distinct opposite the seventh, and from thence backwards as far as the fifteenth somite it exhibits an irregular linear thickening. Over this posterior part of its course the Wolffian duct occurs as a distinct structure. Behind the fifteenth somite the intermediate cell mass extends backwards as a narrow strip somewhat beyond the last somite.

Caldwell* compared the Platypus embryo from an egg just laid to a chick of about 36 hrs., but beyond the number of somites being about the same in both, there is hardly any other point of comparison. In a chick of this age the medullary groove is closed right down to the sinus rhomboidalis, the head is covered by the amnion, the three cerebral vesicles and the optic vesicles are well developed, the heart is formed and already bent, the vascular area differentiated and the blood circulating; whereas in the Platypus embryo at about the time of laying, the medullary plate is practically flat, vascular area and amnion are non-existent, while the heart is represented by two lateral Anlagen at the periphery of the anterior extensions of the lateral plates of mesoderm.

* Proc. Roy. Soc. N.S.W. Vol. xviii. 1884, p. 120.

In fact we are not acquainted with any embryo which reaches the dimensions mentioned above and is possessed of such a number (17 pairs) of somites and which yet remains, with the exception of a slight head fold, absolutely flat.

Selenka's* figure (fig. 1 Taf. xxi.) of a three days' Didelphys embryo does however present considerable points of resemblance to the Platypus embryo under consideration, though it is very much smaller (4.5 mm.) and possesses only fourteen somites.

In both embryos the medullary plates are practically flat, double heart Anlagen are present, and head fold formed. The appearance of the anterior end of the medullary plate of the three days' Opossum closely resembles that of the Platypus embryo; and further, in the region of the future mid-brain the same lateral mesodermal thickenings occur (*vide* Selenka's fig. 4, Taf. xx. y.) as we have described above, though in the Opossum they are not so marked as in our embryo. According to Selenka these mesodermal thickenings "gehören offenbar zur Urwirbelplatte des Kopfes."

In the Opossum embryo neither the Wolfian body nor the auditory plates are indicated, nor are there any neuromeres described. It however seems highly probable to us that the structures situated in the region of the hind-brain which Selenka regards as the anterior five somites are in reality not somites at all but true neuromeres. A comparison of his fig. 4, Taf. xx., which represents a slightly younger embryo, with the above-mentioned figure renders this view still more likely. In his figures the structures regarded as the anterior five somites extend inwards from the edges of the medullary plate to within a short distance of the mesial line, and in surface view appear related essentially as are the neuromeres in our embryo; while the remaining somites of the trunk, instead of ending on a level with the edges of the medullary plate, extend out beyond them.

Further, his transverse section (fig. 3, Taf. xxi.) through the region of the hind-brain and passing through one of these supposed somites shows no mesodermal differentiation which could

* Studien über Entwick. der Thier. iv. Lief. i Abt.

give rise to the appearance seen in surface view. The mesoderm extends out as a continuous plate of uniform thickness beyond the edge of the medullary plate, whereas the medullary plate itself shows a very noticeable thickening as compared with that of the other sections figured.

The marked retardation in the formation of the medullary folds and in the folding off of the embryo is one of the most characteristic features of the embryo at this stage. This may be due, as suggested by our friend Prof. J. T. Wilson, to the mechanical effect of the rapid imbibition by the ovum of nutritive fluid secreted by the uterine glands.

The mature ovarian ovum, according to Caldwell,* measures only 2.5 to 3 mm. in diameter. After the entrance of the ovum into the Fallopian tube the shell membrane and proalbumen are added externally to the vitelline membrane, and at the same time the ovum is increasing in size by the absorption of fluid. The youngest stages in our possession are eggs in which segmentation has advanced to some extent; they measure 5 mm. in diameter, and possess a distinct and resistant shell membrane separated from the vitelline membrane by a thin layer of proalbumen. As development proceeds this layer of proalbumen is soon wholly absorbed, and in the eggs under consideration the blastodermic vesicle tightly distended with fluid fitted closely around the inner surface of the fully formed shell, the vitelline membrane being no longer recognisable. During the rapid imbibition of fluid by the blastodermic vesicle, and the consequent increase in size of the whole ovum, the wall of the vesicle including the embryonal area is closely pressed against the surrounding vitelline and shell membranes. It therefore seems reasonable to suppose that under such conditions, only those structural features of the embryo are produced which do not involve any upgrowths of the wall of the vesicle. Once the definite shell is fully formed around the egg and no possibility exists of its obtaining a further supply of maternal nutritive material, the normal development of bodily

* Phil. Trans. 1887.

form by folding of the blastoderm is enabled to occur by the embryo making room for itself, so to speak, by the using up of the fluid contents of the vesicle.

Against the view here put forward, it may be urged that in certain other forms there is a similar rapid increase in size of the blastodermic vesicle by the absorption of fluid, and yet there is no retardation in development. In *Didelphys*, for example, the blastodermic vesicle, according to Selenka, increases in one day from a diameter of 6 mm. to one of 15 mm., and at the end of this time the embryo is folded off, the medullary groove is closed and the amniotic folds developed. All these processes can, however, easily occur on an expanding blastodermic vesicle lying naked in the cavity of the uterus and devoid of any such mechanical obstacle as would be presented by the presence of a resistant shell membrane.

Ectoderm.

The ectoderm forms a continuous covering for the whole of the blastodermic vesicle. It consists, except in the regions to be subsequently mentioned, of a single layer of polygonal cells. Over the greater portion of the embryonic area the cells are much flattened, while in the head region of the embryo and in the extra-embryonic region of the wall of the vesicle they appear cubical in section.

Medullary plate.—The medullary plate is, as already mentioned, still practically flat. Medullary folds are only present in the anterior region of the future fore-brain; their appearance in this region is probably to be associated with the very early appearance of the optic grooves. The plate consists of elongated cells, the nuclei of which are situated at different levels simulating the appearance of several layers of cells. The lateral portions of the plate are thickest, and are connected by a median much thinner portion which sends down a keel-shaped process in some parts to meet the notochord. Along the median portion of the plate there runs a distinct groove—the “*Rückenfurche*.” Beginning as a shallow groove slightly behind the anterior end of

the medullary plate, it gradually becomes deeper posteriorly, attaining its maximum depth just anterior to the 1st pair of somites, where it is distinctly V-shaped (fig. 7, *d. fr.*). Behind this point it gradually becomes shallower again until in the region of the 8th somite the medullary plate is almost flat, and much thinner than anteriorly (figs. 9 and 10, *md. p.*). Posterior to the somites the plate gradually increases in breadth to form the sinus rhomboidalis which invests the primitive streak. The extreme anterior end of the medullary plate is quite flat, destitute of a median groove, and separated from the underlying proamnion by the head fold. It therefore consists of two layers, a thicker upper and a thinner lower layer, separated from each other by a narrow space (figs. 1, 15 and 16).

Immediately behind the anterior end of the medullary plate its margins become upturned to form the medullary folds which are conspicuous in the photo-micrograph as the two dark lines on either side of the future fore-brain. A transverse section through the middle region of the fore-brain is shown in fig. 2. In the middle of the section is a well-marked groove (*d. fr.*) separated by elevations of the medullary plate from two lateral grooves (*op. gr.*) bounded externally by the medullary folds which curve slightly inwards above the grooves. The median groove will form the future first cerebral vesicle, while the lateral grooves we regard as the Anlagen of the future optic vesicles. Heape* figures a section very similar to our fig. 2 through the optic grooves of the Mole (Stage F.), and comments on their very early appearance, while the medullary groove is still widely open. Posteriorly each optic groove deepens, becomes somewhat V-shaped in section, and at the same time its floor thickens, eventually forming a hollow outgrowth which arises from the bottom of the groove and proceeds outwards and downwards (fig. 3). An appearance similar to this has not been described, so far as we are aware, for any other embryo, and from the evidence at our disposal it would be rash to speculate too far as to its probable significance. The whole

* Quart. Jour. Micros. Science, Vol. xxvii. 1887, fig. 16, Pl. xl.

appearance somewhat suggests a precocious formation of the secondary optic cup, but whether this is so or not can only be settled by the examination of older stages. We are convinced, however, from the examination of serial transverse sections through the region in question, that the appearance is not caused by any artificial folding. Longitudinal sections of our second embryo also exhibit a series of appearances contradicting such an interpretation.

Neuromeres.—As already mentioned four distinct pairs of neuromeres are present in the hind-brain and a less marked pair in the anterior region of the mid-brain. The mid-brain neuromeres are not so distinctly marked off from the medullary plate as those of the hind-brain. It is, however, obvious in longitudinal section as a distinct local thickening of the medullary plate (fig. 16, N.) corresponding to the region marked N in the photo-micrograph.

In longitudinal section the neuromeres exhibit the characteristic arc-shaped form originally described by Orr* in the Lizard (*Anolis*), and afterwards by McClure† in the Chick, in *Amblystoma* and *Anolis*, and by Waters‡ in the Cod.

The neuromeres in the hind-brain of *Platypus* exhibit very closely the characters described by Orr for those of the hind-brain of the Lizard. It must, however, be remembered that in the embryo Lizard, to which Orr's description applies, the medullary canal is closed, while in the *Platypus* embryo the medullary plate is still flat, so that the outer surface of the medullary canal of the Lizard corresponds to the undersurface of the medullary plate in our embryo, and his inner surface to our upper surface.

Each neuromere as seen in longitudinal section (fig. 16, N.) is formed by an arc-shaped bulging on the under side of the medullary plate. Adjacent neuromeres are separated from each other by well-marked constrictions on the under side of the

* Orr, Journ. Morphology, Vol. i, 1887, Pl. XII. fig. 5.

† McClure, Journ. Morphology, Vol. iv. p. 35-56.

‡ Waters, Quart. Journ. Micros. Science, Vol. xxxiii. p. 457-472.

medullary plate, while on the upper side, opposite the constrictions, there are slight transverse ridges.

The elongated cells of which each neuromere is composed are distinct from those of its neighbours. The cells are arranged radially from the upper surface of the neuromere, and their nuclei are slightly more numerous just below that surface (fig. 18). In the hind-brain of the lizard, on the other hand, according to Orr, the nuclei are more numerous towards the outer surface of the neuromere, *i.e.*, towards the undersurface in the medullary plate stage.

In transverse sections the first neuromere of the hind-brain appears as a thickening of the medullary plate with two bulgings on its ventral side—a smaller one situated near the middle of each half of the medullary plate, and a larger one at the outer edge of the plate [fig. 19 (2)]. The outer bulging projects considerably beyond the lateral margins of the medullary plate in the inter-neuromeric region.

The second neuromere [fig. 19 (4)] is less marked than the first, but also possesses mesial and lateral bulgings. The third neuromere [fig. 19 (6)] is on surface view the most distinct of the four. It possesses a single large bulging at its outer edge. The fourth neuromere [fig. 19 (8)] is the least distinct; it possesses, like the first and second, two enlargements of which the lateral one is the larger (fig. 17). Immediately behind the fourth pair of neuromeres of the hind-brain the medullary plate is thickened, but the thickenings are not limited behind by constrictions, and for the present we leave it an open question whether these are to be regarded as a fifth pair of neuromeres or not.

Neuromeres in the fore-brain were not observed. All that we can definitely say at present, then, is that in the head region of the Platypus embryo of this stage a single pair of neuromeres exist in the mid-brain and four distinct pairs in the hind-brain. As Locy* has observed in *Squalus acanthias*, and *Amblystoma*, so in Platypus the neuromeric segmentation appears very early, indeed

* Anat. Anz. ix. Bd. p. 393-415.

before the formation of the medullary folds. The same observer has also insisted on the fact that the neuromeric segmentation is primitively ectodermic and entirely independent of any mesodermic segmentation—a view with which the conditions in *Platypus* are in complete agreement.

Auditory plates : The auditory plates are situated laterally to the neuromeric region of the hind-brain, their anterior edges being on a level with those of the second pair of neuromeres. Each consists of a thickening of the ectoderm which is distinctly grooved longitudinally (fig. 6, *aud.*). The appearance of the auditory plates in *Platypus* while the medullary plate is still flat is noteworthy.

Cranial ganglia are not yet developed. However, in the interval between the third and fourth pairs of neuromeres and opposite the posterior portions of the auditory plates there occurs on each side a distinct downgrowth of the ectoderm just external to the outer edge of the medullary plate. This downgrowth is similar to the “*Zwischenrinne*” described by His* in 1879. Beard,† Rabl,‡ Chiurugi,§ and others have observed a similar structure, but do not regard it as concerned with the development of the cranial ganglia, Goronowitsch,|| indeed, being of the opinion that it is an artificial production of the paraffin bath.

There remains to be noticed a longitudinal strand of cells on each side lying close beneath the ectoderm just external to the edge of the medullary plate and passing slightly inwards below its outer margin (figs. 8 and 9, *le.*). The strands are found in the trunk region of the embryo extending from the first pair of somites anteriorly to about the fourteenth pair posteriorly. They are much larger and more distinct anteriorly. Whether these strands are ectodermal in their origin and ganglionic in their significance

* His, Untersuchungen über die erste Anlage des Wirbelthierleibes—Leipzig.

† Beard, Quart. Journ. Micros. Sc. Vol. xxix.

‡ Rabl, Morphol. Jahrb. Bd. xv.

§ Chiurugi, Arch. Ital. de Biologie, Bd. xv.

|| Goronowitsch, Morph. Jahrb. Bd. xx. Heft 2, p. 201.

could not with certainty be determined at this stage. They exhibit no cellular connection with their surroundings and may possibly represent the detached neural crest ("Zwischenstrang") of which no other representative is present.

Entoderm.

The entoderm of the embryonic area presents no very special features. It is a single layer of flattened cells, the nuclei of which are fairly close. Laterally the cells become more elongated and the nuclei consequently are further apart. Here and there in the embryonic area these flattened entodermal cells are interspersed with large cells distended by the presence in their interior of several yolk spheres (*cf.* fig. 22, *vit. ent.*). Further out these yolk-containing cells become more numerous and eventually form the entire inner lining of the blastodermic vesicle. Their structure is described later in connection with that of the vesicle. The only differentiation of the embryonic entoderm is found in the region of the future pharynx. The cells lying just internal to the amniocardial vesicles have assumed a cubical shape, and form a narrow thickened band on each side extending back to the region of the heart Anlagen (fig. 5, *ent. ph.*). These two bands represent the pharyngeal entoderm of this region.

Notochord: The notochord in surface view is seen to terminate about the middle of the future fore-brain, and sections through this region show that the notochord is here represented by a thickening of the entoderm forming a median band with which the mesoderm is continuous laterally. Many of the cells in this anterior region of the notochord exhibit mitotic division (fig. 14, *nch.*). This median thickening as traced back becomes more marked and more sharply limited laterally though it is not yet distinct from the entoderm. It is in contact above and for some distance behind this point with the keel-shaped process of the medullary plate. Then just posterior to this the notochord becomes distinct as a small rounded mass closely connected with the entoderm below and in contact with the keel-shaped process of the medullary plate above (fig. 4). Then, from about the

middle region of the mid-brain up to a short distance in front of the first somite, the notochord lies below the keel of the medullary plate and is connected with the entoderm by a thin cellular filament (fig. 5). Somewhat anterior to the first somite the notochord becomes entirely free from the entoderm, and continues in this condition to its posterior end where it passes into the head process of the primitive streak. The notochord increases in size somewhat after becoming entirely free from the entoderm. It is then distinctly rod-shaped, while anteriorly it is somewhat oval in section.

The notochord is relatively of very small size in *Platypus*. Heape* has also noticed a similar condition in the Mole, and he regards it as due to the very early appearance of the nervous system.

Mesoderm.

The mesoderm is at this stage established as two lateral wings distinct from the ectoderm and entoderm except at certain regions in the axial line, viz.:—At the anterior flattened-out end of the notochord, in front of the blastopore in the region of the head process, and behind the blastopore in the region of the primitive streak. As already mentioned in the description of the surface view of the embryo, the mesoderm lying on either side of the anterior end of the embryo forms two sharply limited plates to which we have given the name of mesodermal head plates as distinguished from the mesoderm of the rest of the body.

The head plates of mesoderm (Pl. ix., *h.p. mes.*) are lateral thickenings on either side of the future fore- and mid-brains, and show no signs of segmentation. Their outer contours are directly continuous with the forward continuation of the outer boundaries of the protovertebral zones of mesoderm. Their very distinct posterior boundary is not due to the entire disappearance of mesoderm at this point, but to a very marked thinning of the same.

* Quart. Journ. Micros. Science, Vol. xxvii. 1887, p. 139.

A transverse section through the middle region of the head plate is shown in fig. 4. Here, below the medullary plate, the mesoderm exists in the form of scattered stellate cells, while laterally to the outer edges of the medullary plate the cells are more numerous and more closely packed, especially immediately below the ectoderm and at the outer rim of the head plate. This thickened rim marks the outer contour of each plate as seen in surface view. Beyond this rim the mesoderm is divided by the development of a cœlom into two layers, an upper thin layer of flattened somatic mesoderm cells and a lower thicker layer of somewhat cubical splanchnic mesoderm cells. The narrow cœlomic spaces thus enclosed when traced posteriorly are found to be the most anterior parts of the body cavity, and for them we adopt Minot's* term amnio-cardial vesicles.

The amnio-cardial vesicles extend forwards as two horns beyond the anterior end of the embryo. They converge towards the median line without, however, uniting, and practically limit a small area (the proamnion) in which mesoderm is absent. The proamnion is of very small extent and lies immediately in front of and below the anterior end of the medullary plate (figs. 1 and 15, *pra.*). Behind the posterior limits of the head plates the mesoderm becomes reduced to a very thin layer, and is absent altogether over a limited area just anterior to the outermost portion of each auditory plate (fig. 5), and here ectoderm and entoderm come into contact as in the proamnial region. The thin areas of mesoderm behind the head plates are very obvious in the photo-micrograph as the lighter areas in the middle of which the auditory plates are situated. These thin areas are wholly confined to the forward continuations of the protovertebral zones of mesoderm. Externally to the thin areas are the forward extensions of the lateral trunk zones of mesoderm, along the outer edges of which are situated the symmetrical heart Anlagen.

The mesoderm in the hind-brain region is entirely destitute of segmentation. It consists, below the medullary plate, of scattered

* Human Embryology, 1892, p. 198.

stellate cells which become somewhat more compact below the ectoderm and immediately external to the edges of the medullary plate. The outer margin of this more compact portion of the mesoderm corresponds to the outer limit of the forward prolongation of the protovertebral zone of mesoderm, and is visible in the photo-micrograph as the dark contour bounding this area. Beyond this line the mesoderm is split into the somatic and splanchnic layers. The somatic layer is composed of a single layer of cells and is closely applied below the ectoderm; the splanchnic layer is thicker, especially where it is inbulged over the heart endothelium (figs. 5 and 6, *spl.*). The two layers unite again into a single layer a little way external to the lateral heart Anlage. The lateral extension of the unsplit mesoderm beyond the heart Anlage is, however, very small, so that the lateral extent of the coelom practically corresponds in this region with the lateral extent of the mesoderm. From this point backwards the mesoderm gradually extends more and more outwards until it reaches its maximum extension opposite the posterior end of the embryo.

Behind the heart Anlagen proper the somatic layer of mesoderm becomes very much thicker than the splanchnic (figs. 7, 8, 10 and 12), and it continues in this condition to the posterior end of the embryo. At the same time the two layers become more closely applied to each other and the coelom is reduced to a narrow cleft.

Just over the venous trunks leading to the heart Anlagen the two layers are unsplit, thus dividing the coelom into a more mesial and a more lateral portion.

The splitting of the more mesially situated part of the lateral mesoderm becomes more indistinct posteriorly, so that opposite the anterior somites the mesial part of the ventral coelom is largely obliterated and there exists external to the somites a mass of unsplit mesoderm (fig. 8).

The par-axial mesoderm immediately in front of the first pair of somites, though not transversely limited in front as a distinct segment, has essentially the same appearance in section as that of the first somite. It forms on each side a distinct and compact

plate lying close below the ectoderm immediately external to the edge of the medullary plate. Beneath it there exist looser stellate cells which are continuous with it at both ends (fig. 7, *mes. av.*).

Mesodermic somites: The appearance of the seventeen pairs of somites as seen in surface view has already been described. With the exception of the first three and the last three the somites are practically identical. In transverse sections (figs. 8 and 9, *m.s.*) they present an oblong form compressed dorso-ventrally and extend some distance beneath the medullary plate. They possess in their whole breadth very distinct myotomic cavities bounded by dorsal and ventral walls composed of somewhat stellate cells. The cavity is sometimes interrupted by strands of cells passing between the two walls.

The ventral walls of the first three pairs of somites have become converted into stellate mesenchyme cells, and in the first at least the myotomic cavity is no longer distinguishable (fig. 7). Their dorsal walls form a somewhat arched plate of closely compacted cells.

The last three pairs of somites do not possess well marked cavities. They consist of about two layers of cells connected by cellular bridges (fig. 10, *m.s.*).

Lateral trunk mesoderm and ventral coelom: The lateral mesoderm appears directly continuous with the first three somites, without any intermediate cell mass, while from the 4th onwards a distinct intermediate cell mass is present between the two (figs. 8 and 9).

Except opposite the posterior somites the cleavage of the lateral mesoderm does not extend right up to the somites, the coelom only appearing some distance out. The splanchnic layer is only one cell thick, while the main portion of the mesoderm continues out as a thick somatic layer. This gradually thins as it passes out, becomes reduced to a single layer of cells, and ultimately fuses with the splanchnic layer to constitute a single mesodermal layer marginally.

The dark area in the photo-micrograph just external to the somites is the optical expression of this thick somatic layer of mesoderm. The outer limit of the dark area marks the place where the latter becomes reduced to a single layer.

The ventral cœlom is, in the region of the 1st somite and just anterior to it, coextensive with the thickened portion of the somatic mesoderm seen in surface view, while posteriorly it extends out beyond the point where the latter becomes thin. Further back still the cœlom gradually becomes reduced in extent until in the region of the 9th to the 13th somites the mesoderm is no longer split (fig. 9, *mes.*).

Opposite the 14th or 15th somites the mesoderm again becomes split, the cœlom extending close up to the intermediate cell mass (fig. 10).

Behind the somites the protovertebral zones of mesoderm are directly continuous with the lateral plates, while the splitting of the mesoderm does not occur until some distance out (fig. 12).

The mesoderm continues some distance beyond the hinder end of the primitive streak, and here the cœlomic cavities gradually extend inwards towards the mesial line and fuse with each other, so that the cœlom forms a continuous space. In this region the tail fold of the amnion will probably be developed.

Primitive streak: In surface view the notochord is seen to become gradually thicker at its posterior end and to terminate finally in a distinct longitudinal thickening situated about the middle of the sinus rhomboidalis. The continuation forwards of this enlargement to join the notochord is the head process of the primitive streak, while behind it is the primitive streak itself, just visible in the photo-micrograph as a whitish line.

Sections through the primitive streak show that mesodermal cells are being rapidly proliferated off from the ectoderm forming the floor of the primitive groove along its whole extent, and that the lateral wings of mesoderm are directly continuous with this axial streak of cells (figs. 12, 13, and 24). At the anterior end of the primitive groove ectoderm, mesoderm and entoderm are fused together in the axial line (figs. 23 and 24) and form the

enlargement already referred to which projects as an elongated eminence composed of rounded cells at the anterior end of the primitive groove (figs. 11 and 23). In the hollow at one side of this eminence the blastopore (*bl.*) is situated. The blastopore leads into the blastoporic canal which runs forwards in the head process for a distance of 16 mm., and opens by a lateral opening into the cavity of the blastodermic vesicle (fig. 21, *bl. op.*). The inner opening of the blastoporic canal appears as a break in the entoderm. The walls of the canal are wholly composed of mesoderm. The lumen of the blastoporic canal is not a single one, but is divided up by bridges of cells into two or three smaller canals (fig. 22, *bl. c.*). A similar duplication of the canal has been observed by Kölliker* in the rabbit, by Bonnet† in the sheep, by Zumstein‡ in the chick, and by Spee§ in the guinea-pig; hence the latter observer regards it as probably of general occurrence in the formation of the chorda in mammals.

The head process runs forwards from the front end of the primitive streak, distinct from the ectoderm though closely applied below it. Laterally it is continuous at intervals with the mesoderm, while below it exhibits traces of cellular connection with the entoderm. This connection with the entoderm is interesting in view of the observations of Carius|| that the head process is free at first and only subsequently unites with the entoderm. Just anteriorly to the inner opening of the blastoporic canal the head process is connected with the ectoderm by a narrow median strand exhibiting a similar appearance to that shown by Graf Spee¶ for the guinea-pig. Two small lumina at this stage not continuous with the blastoporic canal occur in the head process just anterior to the inner opening of the canal (fig. 20, *nch. c.*),

* Sitzungsber. Phys-med. Gesellschaft in Würzburg. 1883.

† His's Archiv. 1884.

‡ Mesoderm. Svo, Bern, 1887.

§ Anat. Anz. iii. Jahrg. 1888.

|| Svo. Marburg, 1888.

¶ Anat. Anz. 1888, p. 319 (et fig. 2).

while a short distance further forward a single distinct lumen occurs, but it is confined to one section. Apparently we have here to do with the last traces of the notochordal canal.

The head process diminishes in thickness anteriorly and finally passes into the posterior end of the notochord.

Wolffian duct and body: The appearance of the Anlagen of the Wolffian duct and body has already been described in surface view. In sections of its anterior region from the 4th to the 7th somites the united Anlagen of the Wolffian duct and body appear as a solid cord of cells projecting from the intermediate cell mass. The greater part of the cord lies free between the outer edges of the somites and the lateral mesoderm, while its dorsal surface approaches within a short distance of the ectoderm (fig. 8, *w. b.*). As the cord is traced backwards it is found to become gradually constricted in its middle region, while its dorsal portion broadens out, until it becomes somewhat dumb-bell-shaped in form. Its basal portion is now very distinctly connected with the lateral mesoderm on its outer side. On its inner side, however, the connection with the somites is not now so well marked, and in places this connection is completely lost. At about the level of the 6th somite the constriction of the middle region of the cord is much more marked, and it here consists of a ventral larger rounded mass connected by a narrow isthmus with a dorsal much thinner flattened band. The upper portion is the Anlage of the Wolffian duct, while the lower is the Anlage of the Wolffian tubules. Then, by the gradual disappearance of the connecting isthmus the mass comes to consist of a dorsal band-like Wolffian duct Anlage (fig. 25, *w. a.*), united at its mid-region to the underlying Anlage of the tubules (*w. t.*). Finally, opposite the 7th somite the narrow connection between the duct Anlage and the Anlage of the tubules is lost altogether, and the two become separate (fig. 26).

The outer edges of the duct Anlage lie close below the ectoderm which, just over the duct, is very thin and delicate, and with very few nuclei as compared with the rest of the ectoderm. Very

often it is broken in the process of section cutting—a feature Martin* has also met with in the case of the rabbit (*cf.* his fig. 7 A-D. Taf. vii. in this respect with our figs. 25 and 26).

The Wolffian duct Anlage is now distinct not only from the somites and lateral mesoderm, but also from the Anlage of the tubules. However, it does again become connected with the tubule Anlage, and also with the lateral mesoderm at its outer edge, over a very short distance. The Anlage of the tubules consists of a somewhat rounded mass in transverse section, with its cells arranged in a radial manner round its somewhat clearer centre. In this in some sections a distinct lumen occurs (fig. 26, *w.t.*) The tubule Anlage is now only distinctly connected with the lateral mesoderm, the connection with the somites being lost more or less completely. Some sections indeed (fig. 26) show the tubule Anlage as an isolated rounded mass, below which passes a thin layer of loose cells of the intermediate cell mass.

The duct varies somewhat in width in different sections, and this gives rise to the irregular linear thickening previously mentioned as seen in surface view. As it is traced to its distal end the duct is found to become gradually reduced to a thin flat plate somewhat thicker in the middle and thinning off laterally, and separated by a very small interval from the overlying thin area of the ectoderm. At the same time the Anlage of the tubule becomes reduced in size and its differentiation from the rest of the intermediate cell mass largely disappears, though it is still distinguishable as a compact mass of rounded cells forming a projection from the loose cells of the mass.

In its posterior region the outer edges of the now very thin Wolffian duct curve slightly upwards towards the ectoderm, and thus the entire Anlage has here a somewhat arc-shaped appearance. The duct is here of considerable width, though not more than two cells in thickness in its middle region. Finally, with the upturned edges of the Anlage, the ectoderm becomes continuous by means of fine but very distinct strands (fig. 27, *w.d.*), and there is thus

* Archiv f. Anat. 1888.

enclosed between the two a small space. Behind the point where the connection of the edges of the Wolfian duct with the ectoderm is first seen, the duct rapidly becomes reduced in size and approaches closer to the ectoderm (fig. 28, *w.d.*).

Finally it is reduced to a single cell, which passes directly over into the ectoderm (fig. 29, *w.d.*).

From these observed facts we are inclined to believe that the Wolfian duct in *Platypus* has an ectodermal origin. We cannot assert this dogmatically from the examination of one stage; yet the balance of evidence is in favour of this view, and indeed from the facts at our disposal it is the only view we can put forward.

The duct certainly does not grow backwards by proliferation from its posterior end as Martin states to be the case in the rabbit, for as opposed to the condition in that animal, where according to Martin the Wolfian duct at its extreme posterior end is thicker than just anterior to that point, in *Platypus* the duct gradually becomes thinner posteriorly, and as we have described, passes directly over into the ectoderm. Nor can the duct grow backwards by the addition of cells from the mesoderm, for as we have shown the Wolfian duct is quite distinct posteriorly from the Anlage of the tubules and from the adjacent mesoderm. We are therefore inclined to believe that the Wolfian duct in *Platypus* grows backwards by separation or delamination of cells from the ectoderm.

Just as the differentiation of the Anlage of the Wolfian duct from the ectoderm is lost as it is traced posteriorly, so the differentiation of the Anlage of the tubules from the intermediate cell mass is also lost. The Anlage of the tubules can, however, be traced behind the termination of the Wolfian duct as a narrow strand of rounded cells readily distinguishable from the looser branching cells of the rest of the intermediate cell mass. The relations of the Anlage of the tubules to the intermediate cell mass in *Platypus* is thus essentially the same as Martin has described for the rabbit.



In its topographical relations the Wolffian duct in *Platypus* agrees with the conditions described by Meyer* in man, where according to him the proximal part of the duct leads back from the mesoderm while its distal portion is connected with the ectoderm. Both Meyer and Martin agree in describing the proximal part of the duct as mesodermal in origin, but as to this we are not in a position to speak with certainty. However, in *Platypus* the proximal part of the united Anlagen of the Wolffian duct and tubules is related essentially as Martin describes for the corresponding portion in the rabbit, and it might well be that as in that animal the proximal portion of the Wolffian duct Anlage arises from the intermediate cell mass in common with the Anlagen of the Wolffian tubules.

Vascular System.

Heart Anlagen: The symmetrically placed heart Anlagen have already been described in surface view as situated in greater part opposite the hind-brain region. Sections, however, show that their anterior ends extend somewhat beyond the posterior limits of the head plates of mesoblast, and we may therefore look upon these head plates as the regions in which the future aortic arches will be developed.

The heart Anlagen at this stage in *Platypus* are essentially similar to those of a rabbit of about nine days.

As the amnio-cardial vesicles are traced from their anterior ends backwards, they gradually increase in lateral extent, and at the same time towards the posterior limits of the head plates the thick splanchnic layer of mesoderm separates from the entoderm. In the space thus formed on each side, rounded vasifactive cells appear. Posteriorly these vasifactive cells have formed the vascular endothelium of the anterior cardiac region, and this lies in the gutter-like groove—open towards the entoderm—formed by the inbulging of the thick splanchnic mesoderm into the amnio-cardial coelom. Each heart Anlage consists anteriorly of several

* Arch. f. Mikr. Anat. Bd. 36, 1890.

(2-3) endothelial tubes (fig. 5, *ht. end*) which about the middle region of the Anlage unite into a single tube (fig. 6, *ht. end.*). Traces of a septum are, however, still present in the single tube, showing that it has arisen, as Rabl* has observed, by the fusion of at least two smaller ones. On the ventral wall of the single endothelial tube there is a distinct cell mass projecting into the cavity of the same (fig. 6): it apparently represents the ventral part of the septum above mentioned. The endothelial wall is separated by a considerable space from the (splanchnic) mesodermal wall of the heart Anlage. In the middle region of the Anlage the latter exists in the shape of a semi-tubular canal open ventrally (fig. 6, *spl.*), while both in front and behind the groove becomes shallower and more closely applied to the somatic mesoderm.

Posteriorly, at the same time the endothelial tube is reduced in size and is continued backwards as the Anlage of the sinus venosus and omphalo-meseraic vein, and with this other endothelial tubes unite. Near its posterior end each venous Anlage consists of one or two small vessels which disappear finally just anterior to the first somite.

Endothelial vessels have already begun to appear in other parts of the embryonic region, *e.g.*, in the mesodermal head plate and especially where that underlies the medullary plate (figs. 3, 4, 5 and 6). These are not yet connected with the anterior prolongations of the heart Anlage, nor do they appear to contain blood corpuscles. It is worthy of note that the endothelial vessels may also occur in the somatic mesoderm, between it and the ectoderm. Bonnet† has also observed vessels in the somatic mesoderm in the sheep, but according to him they soon disappear. As already mentioned, a vascular area was not visible in the fresh condition, but sections reveal the presence of vasifactive cells and actual vessels in the extra-embryonic region (figs. 10, 12, 30, *vas. c.*, *b.v.*).

Both the vessels and the vasifactive cells become more numerous opposite the posterior end of the embryo. The vessels exist in

* Morph. Jahrb. Bd. xv. p. 226.

† His's Archiv. 1889. p. 56.

the form of endothelial tubes which may enclose a number of vasifactive cells.

The vasifactive cells constituting blood islands occur in great numbers opposite the posterior region of the embryo between the more compact superficial layer of mesoderm and the entoderm (figs. 12, 30, *vas. c.*). In the mesial portion of this region the vasifactive cells appear to be differentiating to form vessels, while further out they occur in larger or smaller undifferentiated blood islands. The vasifactive cells possess each a large rounded nucleus with a very thin surrounding layer of protoplasm (fig. 30, *vas. c.*).

Structure of Blastodermic Vesicle.

The oval vesicle on which the embryo lies is comparable at this stage to a typical mammalian blastodermic vesicle, and forms in some respects a striking connecting link between the conditions obtaining in the Sauropsida and in the Placental Mammals.

The for the most part flattened ectoderm cells of the embryonic area pass into the more cubical cells forming the outer layer of the wall of the vesicle. Both ectoderm and entoderm form perfectly continuous layers all round the vesicle (fig. 32).

The vesicle, as already described, contained a thin albuminous fluid, while below its thin wall there existed a layer of yolk spheres. Sections and preparations of the wall of the vesicle mounted whole show that these yolk spheres are all intracellular. They are contained in large cells—vitelline entoderm cells—which, as has been already stated, are sparsely present among the flattened entoderm cells of the embryonic area, and immediately outside this are more abundant; while throughout the rest of the non-embryonic portion of the vesicle they constitute the entire inner entodermic lining of the latter.

The vitelline entoderm cells are of great size and are almost entirely occupied by large yolk spheres (figs. 30-33, *vit. ent.*). Each cell contains a large nucleus rendered somewhat irregular by internal compression by the yolk spheres. The nucleus is generally situated on the side of the cell next the ectoderm (fig.

33). The greater part of the chromatin of the nucleus is contracted into a star-shaped mass in the centre, while smaller particles of chromatin occur sparsely around this.

The mesoderm extends round from a quarter to a half of the circumference of the vesicle in the posterior region of the embryo. The lateral extension of the mesoderm diminishes gradually as one proceeds forwards, so that in the region of the heart Anlagen it extends only a short distance laterally to them, while in the region of the head plates of mesoderm the amnio-cardial vesicles form its outermost limit. In front of the embryo beyond the point where the amnio-cardial vesicles converge to limit the pro-amnion, mesoderm is entirely absent.

Beyond the cœlom there extends out a layer of flattened mesodermal cells between which and the vitelline entoderm is a layer of numerous rounded vasifactive cells (fig. 30, *vas. c.*). Further out these two mesodermal layers are continued into a layer of somewhat spindle-shaped cells with large rounded nuclei which forms the outermost portion of the extra-embryonic mesoderm (fig. 31, *mes.*). It is from the relatively very early great lateral extension of the mesoderm and from the presence of a very distinct yolk-containing entoderm that we regard the vesicle of the Platypus embryo of this stage as transitional between the yolk sac of Sauropsida and the typical mammalian blastodermic vesicle.

In the Sauropsida it is only after most of the yolk has been absorbed that the yolk sac is completely lined by discrete entodermal cells; in the higher mammalia, on the other hand, in the absence of yolk, the entoderm—the homologue of the yolk mass of Sauropsida—is very early able to completely enclose the cavity of the blastodermic vesicle—the homologue of the yolk sac cavity of Sauropsida. The ovarian ovum of the Platypus is as is well known a typical yolk-laden egg, yet at this stage the embryo, instead of overlying a mass of unsegmented yolk, lies on the surface of a two-layered vesicle containing fluid, which is only distinguishable from a typical mammalian blastodermic vesicle through the fact that instead of having a yolk-free entoderm, it possesses an entoderm composed of large yolk-containing cells.

EXPLANATION OF PLATES.

Reference Letters.

am. a. Amniotic area. *amc. v.* Amnio-cardial vesicle. *aud.* Auditory plate. *bl.* Blastopore. *bl. c.* Blastoporic canal. *bl. op.* Internal opening of blastoporic canal. *b. v.* Blood vessels. *cæ.* Coelom. *d. fr.* Median sulcus of medullary plate ("Rückenfurche"). *ect.* Ectoderm. *ent.* Entoderm. *ent ph.* Pharyngeal entoderm. *h. a.* Heart Anlage. *h. pr.* Head process of primitive streak. *hp. mes.* Head plate of mesoblast. *ht end.* Heart endothelium. *le.* Longitudinal strand of cells lying just external to the edges of medullary plate. *m. s.* Somite. *m. s. c.* Cavity of somite. *md. f.* Medullary fold. *md. p.* Medullary plate. *mes.* Mesoderm. *mes. ax.* Paraxial mesoderm in front of 1st somite. *mes. l.* Lateral mesoderm. *N.* Neuromere of mid-brain. *n'-n.^{iv}* Neuromeres of hind-brain. *nch.* Notochord. *nch. c.* Remains of notochordal canal. *op. gr.* Optic groove. *pra.* Proamnion. *pr. g.* Primitive groove. *pr. s.* Primitive streak. *som.* Somatic mesoderm. *spl.* Splanchnic mesoderm. *vas. c.* Vasificative cells. *vit. ent.* Vitelline entoderm. *w. b.* Anlage of Wolffian body. *w. d.* Anlage of Wolffian duct. *w. t.* Anlage of Wolffian tubules.

Plate IX.

Photo-micrograph of *Platypus* embryo from the egg just ready to be laid.
From the dorsal surface. ($\times 5\frac{4}{5}$.)

Plates X.-XIII.

The positions of the sections from which figs. 1-13 are drawn are indicated in the photo-micrograph by corresponding numbers.

All the drawings were made with a Zeiss' camera lucida.

Plate X.

Fig. 1.—Transverse section through the anterior end of the medullary plate, showing its separation from the vesicle, the proamnion (*pra.*) underlying it and the amnio-cardial vesicles (*amc. v.*) laterally.
($\times 70$.)

Fig. 2.—Transverse section of the middle region of the future fore-brain passing through the commencement of the optic groove (*op. gr.*). The median sulcus (*d. fr.*) will form the future medullary groove proper. ($\times 70$.)

Fig. 3.—Transverse section slightly posterior to fig. 2 showing the hollow outgrowth from the floor of the optic groove. ($\times 70$.)

Fig. 4.—Transverse section passing through about the middle region of the head plate of mesoderm (*hp. mes.*). The amnio-cardial vesicles (*amc. c. v.*) form its outer limit. ($\times 70$.)

Fig. 5.—Transverse section between the posterior limit of the head plate of mesoderm and the auditory plate. The section passes through the anterior end of the lateral heart Anlage—the endothelium (*ht. end.*) of which here consists of two tubes. Mesially to the heart Anlage the pharyngeal entoderm (*ent. ph.*) is visible. Mesially to the latter the mesoderm is interrupted over a small area. ($\times 70$.)

Fig. 6.—Transverse section through the middle of the lateral heart Anlage. The endothelium here forms a single tube, though traces of a septum are still visible in it. The (splanchnic) mesodermal wall (*spl.*) of the heart has here a semitubular shape. The section also passes through the 3rd neuromere of the hind-brain (*n'''*.) apparent as a thickening of the medullary plate and through the grooved auditory plate (*aud.*). ($\times 70$.)

Fig. 7.—Transverse section through the region immediately in front of the 1st somite. The paraxial mesoderm (*mes. ax.*) here exists in the form of an arched plate, below which are numerous stellate cells. The lateral mesoderm is not completely split, the cœlom being represented by several interrupted spaces. The median sulcus (Rückenfurche) (*d. fr.*) of the medullary plate is here very marked and the notochord is now quite free from the entoderm. ($\times 70$.)

Plate XI.

Fig. 8.—Transverse section through the 6th somite. The somite somewhat oblong in section, is seen to extend mesially below the medullary plate and to possess a very distinct cavity (*m. s. c.*). The somite is separated from the lateral mesoderm by the Anlage of the Wolffian body (*w. b.*) Ventrally the latter is distinctly connected with the lateral mesoderm, while the connection with the somite is not so distinct. The lateral mesoderm splits some distance out into a thick somatic layer (*som.*) and a thin splanchnic layer (*spl.*). The longitudinal strand of cells (*le.*) immediately external to the edge of the medullary plate and passing inwards below it is also visible. ($\times 70$.)

Fig. 9.—Transverse section through the 7th somite. In this section the Anlage of the Wolffian duct (*w. d.*) is seen to be distinct from the Anlage of the tubule (*w. t.*) underlying it. The latter is

more or less distinct both from the somite and the lateral mesoderm. The lateral mesoderm is not split, the ventral cœlom being absent in this region. The other relations are the same as in fig. 8. ($\times 70$.)

Fig. 10.—Transverse section passing through both the 16th and 17th somites owing to their oblique direction. The somites in this region no longer possess distinct cavities—they consist of an upper and lower layer connected with each other by processes of the cells. Between the somites and the lateral mesoderm there is present the Anlagen of the Wolffian tubules in the form of a strand of cells (*w. t.*) slightly projecting from the intermediate cell mass. The cœlom (*cœ.*) is of great lateral extent, and numerous endothelial vessels (*b. v.*) are visible in the outer part of the section. ($\times 70$.)

Fig. 11.—Transverse section through the blastopore (*bl.*) which is situated to one side of a longitudinal eminence at the anterior end of the primitive groove (*cf.* also fig. 23). The mesoderm is unsplit for a considerable distance out. ($\times 70$.)

Fig. 12.—Transverse section through the primitive groove (*pr. g.*) slightly behind fig. 11. ($\times 70$.)

Fig. 13.—Transverse section through the hinder region of the primitive streak (*pr. s.*). ($\times 70$.)

Fig. 14.—Median portion of fig. 2 more highly magnified. The section passes through the anterior end of the notochord where it spreads out and is represented by an axial thickening of the entoderm. With this thickening the mesoblast is continuous laterally. ($\times 280$.)

Fig. 15.—Longitudinal section of anterior end of embryo passing through the optic groove (*op. gr.*) and the head fold. ($\times 180$.)

Fig. 16.—Longitudinal section of anterior region of the embryo, passing to one side of the median line, especially to show the mid-brain neuromere (*N.*) and the four hind-brain neuromeres (*n'-n^{iv}*). ($\times 70$.)

Plate XII.

Fig. 17.—Transverse section through the anterior portion of the 4th neuromere showing the mesial and lateral bulgings on its under side—the lateral one much the larger of the two and projecting outwards. ($\times 180$.)

Fig. 18.—Longitudinal section through the 3rd and parts of the 2nd and 4th neuromeres especially to show their arc-shaped form. ($\times 280$.)

Fig. 19 (1-9).—Series of transverse sections through the neuromeric region of the hind-brain. Sections 2, 4, 6 and 8 pass through the neuromeres ($n'-n^{iv}$), while 1, 3, 5, 7 and 9 show the normal thickness of the medullary plate in front of and between the neuromeres. ($\times 70$.)

Fig. 20.—Transverse section through the anterior portion of the head process of the primitive streak. Three sections in front of the internal opening of the blastoporic canal. The lumina ($nch. c.$) in the head process represent the last traces of the chorda-canal. ($\times 340$.)

Fig. 21.—Transverse section through the internal opening of the blastoporic canal ($bl. op$) into the cavity of the vesicle. ($\times 340$.)

Fig. 22.—Transverse section through the head process of the primitive streak ($h. pr.$)—9 sections behind fig. 21. The blastoporic canal is represented by three lumina ($bl. c.$). The head process ($h. pr.$) is distinct from the ectoderm, but shows traces of cellular connection with the entoderm. It is more or less continuous with the mesoderm laterally. ($\times 340$.)

Fig. 23.—Transverse section through the blastopore ($bl.$). It opens to one side of a longitudinal projection at the front end of the primitive groove. Ectoderm, mesoderm and entoderm are fused with each other in the axial line. ($\times 340$.)

Plate XIII.

Fig. 24.—Transverse section through the anterior end of the primitive groove ($pr. g.$) immediately behind fig. 24. As in that fig. the three germinal layers are continuous with each other axially. ($\times 340$.)

Fig. 25.—Transverse section through the united Anlagen of the Wolffian duct and tubule in the region of the 7th somite. The Wolffian duct Anlage ($w. d.$) is semilunar in form and is connected at the middle of its ventral side with the tubule Anlage ($w. t.$). The latter possesses a small lumen and is distinct from the somite ($m. s.$), but connected with the lateral mesoderm ($mes. l.$). ($\times 340$.)

Fig. 26.—Transverse section through the Anlagen of the Wolffian duct and tubule some distance behind fig. 25. The Wolffian duct Anlage ($w. d.$) now exists as a flattened band overlying and distinct from the rounded tubule Anlage. Its outer edges are closely approximated to the ectoderm which immediately over t

Anlage of the duct is very delicate, and, as in the preceding figure, has been broken in the process of section cutting. The tubule Anlage is rounded in shape, and consists of radiating cells surrounding a small lumen. It is now free from both the somite and the lateral mesoderm. ($\times 340$.)

Figs. 27, 28 and 29 represent three successive sections through the posterior end of the Anlage of the Wolffian duct. As compared with fig. 26, the Wolffian duct Anlage in fig. 27 is now considerably smaller and thinner, and is connected at its outer edges with the ectoderm. In fig. 28 the Anlage is still more reduced in size, consisting of a single layer of cells, while in fig. 29 it is reduced to a single cell, connected at both ends with the ectoderm. Behind the section from which fig. 29 is drawn there is no longer any trace of the Wolffian duct Anlage. The Anlage of the tubule in fig. 27 appears as a rounded projection of the intermediate cell mass, with radially arranged cells, but in figs. 28 and 29 this radial arrangement is lost, and the Anlage appears as a slight elevation of the mass. ($\times 340$.)

Fig. 30.—Transverse section through the wall of the blastodermic vesicle some distance beyond the amniotic area, showing the ectoderm (*ect.*), vitelline entoderm (*vit. ent.*) and mesoderm. The latter consists of a layer of cells below which occur numerous vasifactive cells (*vas. c.*) ($\times 320$.)

Fig. 31.—Transverse section of the wall of blastodermic vesicle some distance further out than fig. 30. The mesoderm here consists of a single layer of spindle-shaped cells, while vasifactive cells have almost entirely disappeared. ($\times 320$.)

Fig. 32.—Transverse section of wall of blastodermic vesicle at the ant-embryonic pole. Ectoderm and vitelline entoderm are alone present. ($\times 200$.)

Fig. 33.—Vitelline entoderm cells of blastodermic vesicle drawn as seen through the ectoderm. They are filled up almost entirely by yolk spheres; their large and somewhat irregular nuclei are generally situated on the outer sides of the cells next the ectoderm. ($\times 200$.)

A REVIEW OF THE FOSSIL JAWS OF THE *MACRO- PODIDÆ* IN THE QUEENSLAND MUSEUM.

BY C. W. DE VIS, M.A., CORRESPONDING MEMBER.

(Plates XIV.-XVIII.)

The motive to the present inquiry was a desire to ascertain whether additional light might not be thrown on an interesting portion of the Nototherian fauna by the large number of Macropodine jaws, rescued from time to time from the drifts of the Darling Downs, which have been reduced to specific order. It was a task attempted some years ago, and promptly laid aside: partly on account of the uncertainty attaching to the identification of specimens with the types described and figured by Owen: partly in view of the existence of species unknown to that author and the necessity of giving them maturer consideration: partly in the desire to gather a larger body of illustrative material: partly in the hope that when the Volume of the British Museum Catalogue of Fossil Marsupials should be published the labour of determination would be greatly eased. As that hope has been in a measure realised, and as once fertile sources of accumulation have temporarily ceased to be productive, the local investigator, though still compelled to trust very much to his own material and his own judgment, ventures upon the work.

Preparatory to the examination of so considerable a number (over eleven hundred) of dissociated jaws and portions of jaws, wherein specific differences are obscured by that general resemblance in molar form which pervades their several groups, it seemed judicious to ascertain, as far as possible, the nature and range of the variations, individual and specific, in living Macropods which are exemplified by the fossil jaws notwithstanding their imperfections. Provision has therefore been made of skulls of several kinds of Kangaroos and Wallabies in number sufficient to

yield reliable estimates of dimensional extremes and averages within the species, and accurate views of the extent of likeness and difference in form and size maintained among themselves by the species. Information of this kind has been obtained from 479 skulls, namely, of *Macropus giganteus* 80, *M. rufus* 9, *M. robustus* 39, *Halmaturus parryi* 55, *H. agilis* 29, *H. dorsalis* 88, *H. ruficollis* 50, *H. coxeni* 9, *H. thetidis* 19, *H. wilcoxi* 2, *H. stigmaticus* 3, *H. ualabatus* 8, *H. browni* 1, *Onychogale frenata* 4, *Petrogale penicillata* 70, *Dendrolagus lumholtzi* 3. Furnished with this instruction and with a resolution to be chary of assuming anything of a fossil which may not be predicated of a similar living species, it may be possible to thread the maze before us with more confidence in the progress made than would be permissible were the clues less frequent.

Since the mutilations to which the fossil remains have been subjected diminish in number the available points of comparison between them and recent jaws, those data only have been asked from the latter which are given with more or less constancy by the former.

As to measurements, the following are those which have been found the most useful in practice. The length of the full series of cheek-teeth and its width as represented by that of m^3 , the molar most frequently preserved in the fossil state: the length of the premolars, permanent and deciduous: the external length of the mandible from the edge of the masseteric fossa to that of incisive outlet: its internal length from the edge of the intermasseteric foramen to the symphysis: its vertical height, anteriorly at the fore end of the tooth m^1 , and posteriorly immediately behind m^4 : and the thickness of the bone below m^3 . Of less frequent service are the length from the hinder end of the symphysis to the incisive outlet, the length of the diastema, that of the basiocranial axis, the breadth of the palate, and the height of the alveolar process behind the orbit.

The following tables, which may be of some use to others engaged in similar work, are summaries of the measurements taken under the headings which seemed most important. An

intention to throw the sexes into separate tables was abandoned when it was found that although the mean size is less in the female than in the male, individual exceptions are so frequent and pronounced that such separation would afford no guidance in an attempt to discriminate between the sexes of the fossils.

All measurements are in millimetres.

LENGTH OF CHEEK TEETH.

ADULT MANDIBLE.					ADULT MAXILLA.				
	Least.	Great- est.	Number Mea- sured.	Mean.		Least.	Great- est.	Number Mea- sured.	Mean.
<i>M. giganteus</i> ..	...	...	1	48.5	48.1	...	50.7	3	49.2
„ <i>robustus</i> ...	...	...	1	47.4	39.7	...	53.3	4	47.0
„ <i>rufus</i> ...	...	...	...	...	...	...	...	...	...
<i>H. parryi</i> ...	30.5	37.5	16	35.9	37.8	...	41.5	16	39.0
„ <i>agilis</i> ...	36.0	43.5	13	39.9	40.4	...	47.2	13	43.7
„ <i>ualabatus</i> ...	34.5	40.0	2	37.2	37.0	...	42.0	3	38.8
„ <i>dorsalis</i> ...	29	35.3	20	32.0	33.0	...	37.7	17	35.2
„ <i>ruficollis</i> ...	25.5	37.5	13	34.8	36.0	...	40.7	14	38.7
„ <i>wilcoxi</i> ...	30.0	31.0	2	30.5	31.3	...	31.4	2	31.35
„ <i>stigmaticus</i> ...	...	...	1	29.5	...	...	...	1	31.6
„ <i>coxeni</i> ...	29.2	32.0	6	30.4	29.2	...	32.6	5	31.8
„ <i>thetidis</i> ...	29.0	30.5	4	30.2	29.0	...	31.0	4	30.2
<i>O. frenata</i> ...	18.0	23.0	3	20.8	25.7	...	34.5	2	30.1
<i>P. penicillata</i> ...	28.5	31.7	17	30.0	27.5	...	34.5	17	32.6

WIDTH OF FORE LOBE OF M.³

	LOWER.					UPPER.			
<i>M. giganteus</i> ...	6.9	8.9	44	7.6	7.7	10.2	41	8.7	
„ <i>robustus</i> ...	7.0	8.0	9	7.6	7.0	9.0	17	8.0	
„ <i>rufus</i> ...	8.0	8.5	4	8.2	9.9	10.5	5	10.1	
<i>H. parryi</i> ...	5.4	6.9	38	5.9	6.1	7.6	36	7.0	
„ <i>agilis</i> ...	5.7	7.2	19	6.4	7.1	8.6	19	7.8	
„ <i>ualabatus</i> ...	6.0	7.1	5	6.4	7.1	9.2	5	7.8	
„ <i>dorsalis</i> ...	4.9	6.0	41	5.1	6.0	7.3	39	6.7	
„ <i>thetidis</i> ...	4.4	5.4	13	4.9	5.6	6.5	10	5.9	
„ <i>coxeni</i> ...	4.5	5.0	7	4.8	5.5	6.5	7	6.3	
„ <i>ruficollis</i> ...	5.7	7.2	31	6.3	6.5	8.9	34	7.5	
„ <i>wilcoxi</i> ...	4.6	4.6	2	4.6	5.5	6.2	2	5.9	
„ <i>stigmaticus</i> ...	4.7	4.9	2	4.8	5.9	6.1	2	6.0	
<i>O. frenata</i> ...	4.1	4.3	2	4.2	5.5	6.3	2	5.9	
<i>P. penicillata</i> ...	4.5	5.5	44	4.9	5.6	6.8	41	6.5	

LENGTH OF P.⁴

	LOWER.				UPPER.			
<i>M. giganteus</i>	...	...	...	...	6·3	...	8·7	...
„ <i>robustus</i>	...	...	...	...	...	...	8	...
„ <i>rufus</i>	...	...	...	...	...	...	1	...
<i>H. parryi</i>	4·0	...	5·9	...	5·1	...	6·8	...
„ <i>agilis</i>	6·7	...	8·1	...	8·7	...	10·2	...
„ <i>ualabatus</i>	6·1	...	8·4	...	6·8	...	9·9	...
„ <i>dorsalis</i>	5·0	...	6·5	...	5·7	...	7·3	...
„ <i>thetidis</i>	4·2	...	6·0	...	5·5	...	6·1	...
„ <i>coxeni</i>	6·1	...	6·8	...	7·0	...	8·0	...
„ <i>ruficollis</i>	4·0	...	5·0	...	5·8	...	7·6	...
„ <i>wilcoxi</i>	6·6	...	7·5	...	6·6	...	7·5	...
„ <i>stigmaticus</i>	...	...	...	1	...	...	...	1
<i>O. frenata</i>	2·3	...	2·6	...	2·3	...	2·6	...
<i>P. penicillata</i>	5·1	...	6·7	...	5·8	...	8·0	...

	ANTERIOR DEPTH.				POSTERIOR DEPTH.			
<i>M. giganteus</i>	20·2	...	26·0	...	20·2	...	28·5	...
„ <i>robustus</i>	20·0	...	25·5	...	18·0	...	25·1	...
„ <i>rufus</i>	20·0	...	26·6	...	17·6	...	23·0	...
<i>H. parryi</i>	16·7	...	20·0	...	15·0	...	20·0	...
„ <i>agilis</i>	16·5	...	21·1	...	15·7	...	21·1	...
„ <i>ualabatus</i>	14·3	...	17·6	...	13·7	...	15·8	...
„ <i>dorsalis</i>	12·6	...	17·5	...	11·5	...	17·5	...
„ <i>thetidis</i>	10·0	...	13·5	...	10·4	...	13·5	...
„ <i>coxeni</i>	11·4	...	13·4	...	10·1	...	11·5	...
„ <i>ruficollis</i>	14·9	...	19·4	...	14·1	...	20·0	...
„ <i>wilcoxi</i>	11·4	...	12·5	...	11·0	...	12·5	...
„ <i>stigmaticus</i>	10·5	...	12·8	...	10·5	...	12·4	...
„ <i>browni</i>	...	...	...	...	...	...	...	...
<i>O. frenata</i>	11·2	...	11·9	...	9·0	...	11·0	...
<i>P. penicillata</i>	12·0	...	16·0	...	8·1	...	13·9	...

	THICKNESS.			
<i>M. giganteus</i>	11·7	...	16·8	...
„ <i>robustus</i>	11·0	...	14·1	...
„ <i>rufus</i>	13·0	...	13·7	...
<i>H. parryi</i>	10·1	...	12·0	...
„ <i>agilis</i>	10·1	...	14·2	...
„ <i>ualabatus</i>	9·5	...	12·1	...
„ <i>dorsalis</i>	9·0	...	11·0	...
„ <i>thetidis</i>	7·3	...	9·0	...
„ <i>coxeni</i>	7·1	...	8·0	...
„ <i>ruficollis</i>	9·5	...	12·0	...
„ <i>wilcoxi</i>	7·5	...	8·4	...
„ <i>stigmaticus</i>	7·3	...	8·0	...
„ <i>browni</i>	...	...	1	...
„ <i>frenata</i>	5·3	...	6·6	...
„ <i>penicillata</i>	7·5	...	10·0	...

	EXTERNAL LENGTH.				INTERNAL LENGTH.			
	Least.	Great- est.	Number exam- ined.	Mean.	Least.	Great- est.	Number exam- ined.	Mean.
<i>M. giganteus</i>	... 86.0	... 104.7	... 27	... 97.66	62.3	... 76.1	... 27	... 66.5
„ <i>robustus</i>	... 75.5	... 89.0	... 4	... 83.55	57.3	... 71.6	... 4	... 67.5
„ <i>rufus</i>	... 85.7	... 97.0	... 2	... 91.3	68.5	... 72.7	... 2	... 70.6
<i>H. parryi</i>	... 61.1	... 73.1	... 16	... 66.2	49.4	... 56.6	... 16	... 53.6
„ <i>agilis</i>	... 63.2	... 78.0	... 13	... 69.7	38.0	... 46.4	... 13	... 42.0
„ <i>ulabatus</i>	... 55.0	... 63.7	... 3	... 59.1	46.3	... 54.8	... 3	... 49.7
„ <i>dorsalis</i>	... 50.4	... 70.0	... 20	... 58.7	42.5	... 51.8	... 20	... 46.0
„ <i>thetidis</i>	... 42.5	... 49.0	... 4	... 45.7	34.6	... 41.0	... 4	... 37.1
„ <i>coxeni</i>	... 42.2	... 48.2	... 6	... 44.5	34.5	... 38.8	... 6	... 36.5
„ <i>ruficollis</i>	... 60.0	... 70.8	... 14	... 65.1	45.6	... 56.7	... 14	... 51.2
„ <i>wilcoxi</i>	... 44.5	... 48.0	... 2	... 46.2	39.3	... 41.0	... 2	... 40.2
„ <i>stigmaticus</i>	...	...	... 1	... 44.6	...	...	... 1	... 35.0
<i>O. frenata</i>	... 41.1	... 43.5	... 3	... 41.9	25.5	... 36.2	... 3	... 32.4
<i>P. penicillata</i>	... 42.2	... 52.4	... 18	... 47.7	35.5	... 45.8	... 17	... 33.8

With respect to form and structure, attention has necessarily been paid to the shape and sculpture of the several premolars and to their periods of rise and fall in terms of the posterior molars: to the shape, properties and accessory furniture of the true molars: and to the form of the lower contour line of the mandible. Occasionally it has been found useful to notice the shape and direction of the lower incisor, the condition of the symphysis, the level of the inlet of the dental canal, the position of the internal orifice of the lachrymal canal, and status of the anteorbital foramen.

A jaw is accounted *adolescent* in which appears the first trace of wear on the hind lobe of the penultimate molar: it is supposed to be *adult* when the same state of wear obtains in the last molar.

When the posterior surface of an upper molar is excavated vertically and the inner lip of the semifuniculate gorge resulting is raised, this lip in the antecedent teeth appears as an *adpressed fold*.

The term *link* is retained for the longitudinal ridge linking together the several lobes, or the front lobes and their respective talons; *valley* is a term convenient in use to indicate the hollows which are constant between the lobes and frequent on the talons.

The qualification *elongate* applied to molars implies that those of the lower jaw are on the average *one half* longer than broad, or thereabouts.

With one exception the whole of the fossils have been collected at various points on the Darling Downs.

On the ground that "the characters by which Kangaroos and Wallabies are separated from each other are neither sufficiently constant nor important to found generic distinction upon," we are invited by Mr. Thomas to forego the admitted benefit of keeping them apart. The ease and certainty with which the unlearned bushman distinguishes between Wallabies and Kangaroos by their build, gait, and habits, are derived from a kind of evidence to which we are not accustomed to pay much heed, but—that apart—it appears to the writer that in the behaviour of the premolar we have a distinguishing character of sufficient constancy and importance for our purpose. It is rare to meet with an aged wallaby's jaw with fewer than the whole five cheek teeth in place at once. It is equally rare to find even a recently adult kangaroo jaw with all the cheek teeth together in place. In the one a strong progressive movement of the substance of the jaw carries forward all the teeth, and, unhindered by any fixed impediment on the brink of the diastemal declivity, hurries them over it: in the other the hinder teeth, propelled with far less force against the immovable barrier set up by the premolar, are kept on duty throughout life, or, if an anterior molar ever be lost, it is so by lateral out-thrust or decay *in situ*. The comparative unimportance of the premolar function in *Macropus*, expressed in the feebleness and short duration of these teeth, especially of the so-called permanent tooth, and its high functional value in *Halmaturus*, in which the latter is better developed than the deciduous tooth and is to old age one of the best preserved of the grinders, point to physiological differences between the two groups important enough to render the constant transiency or permanency of the premolars a good diagnostic character.

Allowing then the practical convenience of recognising the genus *Halmaturus* to outweigh a theoretical reason which seems to him to lack foundation, the writer proposes to retain that genus for the present.

PALORCHESTES, Owen.

Palorchestes, Owen, I.* 1874, p. 797.

Molars with talons anteriorly and posteriorly; the anterior of the upper and the posterior of the lower the longer; mid valleys of the upper closed on the inner, or on both sides, by a raised basal rim. Lower molars elongate; their links continuous with the outer angles of the lobes. Anterior upper molars with vertical ridges and folds. Upper premolar triangular, nearly equilateral, transversely bicuspid, with a talon fore and aft; lower oblong, unicuspid, with a long posterior talon which is strongly linked to the lobe. Vascular foramen present in the mandible. Lower incisors procumbent, spatulate. Middle pair of upper incisors smallest.

Key to the species.

Size larger; cheek-teeth over 110·0 in length,
anterior talon of $\overline{p^4}$ short; lobe of $\overline{p^4}$ indented
intero-posteriorly *azael*

Size smaller, cheek-teeth below 100·0 in length,
anterior talon of $\overline{p^4}$ produced; lobe of $\overline{p^4}$ exca-
vated intero-posteriorly..... *parvus*

PALORCHESTES AZAEL, Owen.

P. azael, Owen, I. 1874, p. 798; Lydekker, IV. p. 237;
Etheridge, V. p. 186.

P. crassus, Owen, VIII. Vol. xi. p. 7, 1880.

Anterior talon of upper premolar in the half worn state indistinct. The lobe of the lower premolar indented on the posterior surface near the inner side of the link; its area of abrasion subquadrate, extended longitudinally. Size large.

* Numbers like this after authors' names refer to the bibliographical list at the end of the paper.

Dimensions.

Mandibular.—The length of the first three cheek-teeth is 66·1, of the premolar 17·0, of m.³ 29·5, of p.³, mp.⁴, m.¹, m.² 60·0. The width of m.³ is 19·0. The anterior depth of the mandible is 61·5; the thickness 33·5.

Maxillary.—From figure and cast. The entire length of the cheek-teeth is from 117·5 to 122·5, the premolar diameters 18·0 × 18·0, m.¹ m.² are 55·5, m.³ 31·8. The width of m.³ is from 20·5 to 23·1. The breadth of the palate is from 100·0 to 103·2.

The lower molars are proportionately narrow, but not more so than in the existing Macropods, *M. giganteus*, *H. agilis*, and *H. ruficollis*.

Form of teeth.

Maxillary.—The premolar p.⁴ (Pl. XIV. fig. 5) is an almost regular equilateral triangle with convex sides and angles. From a narrow basal rim or talon, which however seems to be restricted to the inner side, the fore end of the crown slopes gently upwards to the horizontally abraded surface of the two cusps. Of these the smaller is placed over the intero-posterior angle, the larger over the middle of the outer side of the base. The cusps are defined by a deep indent between their posterior surfaces, anteriorly by a depression in the inclined plane in front. The posterior basal talon runs from the outer angle to the middle of the hinder surface of the inner cusp. Opposite the posterior indent the talon is long, but behind the outer cusp where it is feebly linked to the middle of the base of that cusp, short.

Molars.—In these as they appear in the cast the anterior basal talons and their linking ridges are distinct, but in the anterior teeth appear chiefly on the inner side, the posterior talons appearing only on the outer; but on the free surface of m.⁴ (Pl. XIV. fig. 6) the hinder talon is seen to extend round to the inner end of the base and to send upwards a strong linking ridge towards the inner end of the crest of the lobe before it. The mesial links run from centre to centre of the lobes which cross the line of the teeth at an oblique angle. The indications afforded by the cast

are confirmed and additional information afforded by the anterior molars of a young individual (Pl. xiv. fig. 3) in the comparatively unworn state which preceded the eruption of p.⁴. The anterior talon of m.¹ is long and broad and its outer valley is subdivided by a second fore link. The mesial valley is closed on the inner side by a raised basal rim and subdivided by a low linking ridge. A broad tapering fold rises upon the face of the fore lobe flanking the outer valley and a feebler one on the opposed face of the hind lobe. The posterior talon is very short, but, like the anterior, continuous from side to side; from its inner third a broad tapering fold or link rises obliquely upwards on the lobe to the inner end of its crest. M.² has no secondary fore link and no folds rising from the outer mid valley, but in other respects repeats the characters of m.¹. In both teeth the inner side of the front talon is broader and deeper than the outer, hence its more persistent appearance in old age.

Mandibular.—P.⁴ (Pl. xiv. fig. 4). The fore end of the lobe has on its inner side a shallow indent terminating below in a small ledge which represents an anterior basal talon. The horizontal surface of abrasion is almost wholly on the inner side of the central line. The link connecting the lobe with the basal talon is wide and elevated. There is a feeble impression behind the middle of the outer surface of the crown.

P.³ (Pl. xiv. fig. 1) is oblong with a large basal talon simulating a posterior lobe; this is linked to the lobe proper, but the link is on the outer side ill-defined. Fore end of lobe so impressed on each side as to give it the appearance of possessing a basal talon with a high linking ridge. Crown suddenly dilated over the intero-posterior angle, where a transverse field of dentine shows the part of the tooth in earliest use.

Molars.—(Pl. xiv. fig. 2). With strongly linked basal talons fore and aft, the mesial and anterior links descending forwards from the outer angles of the lobe yield surfaces of abrasion peculiar in pattern.

Succession of teeth.

The two anterior true molars are still but little affected by wear when p.⁴ has reached a forward stage of incubation, and in the lower jaw p.³ is still in position and little worn when the hind lobe of m.² is well advanced and its fore lobe nearly in use. The upper premolar and last molar are half worn down simultaneously, m.¹ being at the same time reduced almost to a shell. From these data it would seem that the anterior true molars rapidly develop in the young jaw; that the upper premolar probably rises simultaneously with m.⁴, and that it persists to an advanced period of life.

The immediate affinities of *Palorchestes* are with *Halmaturus* rather than with *Macropus*.

Examples—nine.

Maxillary.—A cast of the palato-maxillary region of the skull with all the cheek-teeth; original in the Australian Museum. Like the cast, which has the same history and is numbered M. 2573 in the British Museum Catalogue, it is inscribed "*Macropus*," and is without any doubt from the same mould—Portion of a right maxilla of a young example with m.¹, m.² and the crypt of p.⁴—An isolated m.⁴, an isolated m.³, and an isolated m.².

Mandibular.—Portion of a left ramus, with p.⁴, m.¹, m.², aged, vascular foramen distinct—A left ramus with m.³ perfect and remains of m.² and m.¹, adult, vascular foramen distinct—Part of an isolated m.⁴—Associated rami of a young mandible with i.¹, p.³, mp.⁴, m.², from the Peak Downs.

PALORCHESTES PARVUS, n.s.

Constantly smaller than *P. azeal*, the cheek teeth measuring less than 100·0. Upper fourth premolar with a distinct anterior talon, lobe of the lower fourth premolar deeply emarginated on the posterior surface of the inner side, its area of abrasion narrow, angular, and extended transversely.

Dimensions.

Mandibular.—The length of the entire series of cheek-teeth is 94.7 (1); of the series of true molars 80.0 (1); of the last three molars 58.3 (1); of the last two 39.4 and 41.6 (2); of the last 22.0 and 22.1 (2); of $m.^2$, $m.^3$ 37.0 (1); of $m.^3$ 22.1 (1); of $m.^2$ 20.2 (1); of the premolar 15.0 (1); of $mp.^4$ 18.5 (1). The width of $m.^3$ is from 12.3 to 14.2 (7). The anterior depth is 40.6 and 48.3 (2); the posterior from 35.4 to 49.0 (10); the thickness from 21.8 to 29.9 (10).

Maxillary.—The length of the first four cheek-teeth is 55.9 (1); of the first two molars 37.6 (2); of the last two 37.9 (1); of $m.^1$ 21.2 and 21.5 (2); of $m.^3$ 19.7 (1); of $m.^2$ 20.5 and 21.1 (2). The width of $m.^3$ is from 15.8 to 16.6 (3). The length of the premolar is 15.0 (1).

The mean widths of $m.^3$, upper and lower, are to each other as 13.16:2, agreeing very nearly with those in *H. agilis*, *H. ulabatus*, *H. stigmaticus*, and *O. frenata*.

No gradations in size connect this species, which is rather numerously represented, with *P. azael*, to which it stands in much the same relation as does *S. otuel* to *S. goliath*; its inferiority in this respect is therefore characteristic. Not only so, but the differences between two of its dimensions and the corresponding dimensions in *P. azael* transcend the range of individual variation in size which on the testimony of living Macropods can be allowed within a species. The mean widths of $m.^3$ in the two are 13 and 18, or an excess in the latter approaching one-half of the former. The greatest living difference is found in *P. penicillata*, where it amounts to a third only; in *H. dorsalis* and *H. wilcoxi* it is still less. Again, the mean anterior depth of the mandible in *P. parvus* 44.4 is in *P. azael* increased by more than one-half, and this far exceeds the nearest living approach to it which occurs in *H. dorsalis* where it is considerably less than one-half. Finally, the premolars of *P. parvus* are relatively much larger than those of *P. azael*.

Form.

Maxillary.—Premolar (Pl. xiv. fig. 8). The anterior talon is well developed. Commencing about the middle of the inner side and passing round the fore end, where it gives off a short but distinct linking ridge, it extends on the outer side, but is there interrupted by a fracture of that side of the crown. The inner cusp is defined by a sharp impression on the sloping anterior surface, and posteriorly by a slight vertical indent between it and the outer cusp. The hinder surface of both cusps descends vertically to the low and narrow posterior talon.

Molars.—In a slightly worn tooth exemplified by m.¹ (Pl. xiv. fig. 7) the anterior talon is on the inner side of the fore link subdivided by a lofty but narrow vertical ridge; corresponding to this an oblique fold on the hinder surface of the fore lobe descends to the mid valley, making a sharp angle at its junction with the mid link; this again is opposed by a faint ridge on the anterior face of the hinder lobe, and is repeated in a similar oblique fold on the hinder face of the hind lobe. On the outer side of the latter is a very strong ridge or fold rising from the outer third of the basal talon to the outer end of the crest of the lobe. The mid valleys are closed at each end by a raised basal rim. In worn teeth the more or less abraded remains of the stronger of the several vertical folds are pretty constantly recognisable. The well developed talons fore and aft and the lateral basal rims give a quadrate, self-contained appearance to the teeth, which is retained to the last.

*Mandibular*y.—Premolar (Pl. xiv. fig. 9). The inner side of the fore end of the crown presents a broad groove, ending below in a tumid rim, simulating or representing a basal talon; the posterior surface of the lobe internal to the link is excavated, and the surface of wear encroached upon fore and aft is rendered narrow and angular, while it slopes obliquely inwards and rearwards. The hinder talon is long and concave on the inner side, but on the outer half it is nearly filled by the broad linking ridge, which rising upon it ascends with an inward curve upon the extero-posterior surface of the lobe.

Molars.—The anterior talons are very short, the posterior moderately long and connected with their lobes by strong linking ridges. The fore and mid links run from the outer end of the crest of the lobes to the middle of the fore lobe and anterior talon respectively. The lobes are set obliquely to the line of the teeth, and this obliquity combined with the continuity of the end of one lobe with the middle of the next confers upon the series a facies peculiar to the genus.

Upper incisors.—(Pl. xiv. fig. 10.) The arch formed by the series is broad and flat; the teeth increase in breadth from the central pair outwards, but in the figure the relative width of the outer pair has not been duly represented by the artist.

Succession of teeth.

Of this nothing is known, except that the premolar is retained to old age.

Examples—twenty-six.

Maxillary.—A left maxilla with the first four cheek-teeth somewhat mutilated; aged; traces of the vertical ridges remaining—Part of a left maxilla with m.¹, m.²; adult; vertical ridge distinct—A right maxilla showing the palate lobe entire; teeth m.³ m.⁴; aged; teeth worn to the base—Part of a right maxilla with m.¹, m.²; aged; teeth worn to the base—Fragment of a right maxilla with m.³, adult—Fragment of a right maxilla with m.¹—An isolated m.¹, young—Part of an isolated m.².—Greater part of the base of a skull with all the teeth but the premolars well preserved.

Mandibulary.—A left ramus with all the cheek-teeth; adult; vascular foramen large—A left ramus with all the molars, adult—Hinder half of a left ramus with m.², m.³, m.⁴—Hinder half of a right ramus with m.³, m.⁴; aged; vascular foramen—Hinder half of a right ramus with m.³, m.⁴; aged; vascular foramen—Part of a left ramus with m.³; aging; vascular foramen—Part of a left ramus with m.², m.³; adult—Hinder half of a right ramus with m.³, m.⁴ imperfect.—Fragment of a left ramus with part of

m.¹—A right ramus, teeth destroyed; vascular foramen—Part of a left ramus, teeth destroyed—Isolated tooth, mp.⁴—Isolated tooth, m.²—Isolated tooth, m.⁴—A second example, hinder portion of a left ramus, with m.³, m.⁴; aged.

S THEN U R U S, Owen.

Sthenurus, Owen, I. 1874, p. 264; Lydekker, IV. p. 231.

Protemnodon, Owen, *partim*—Owen, I. 1874, p. 274.

Procoptodon, Owen,—Owen, I. 1874, p. 788; Lydekker, IV. p. 233.

An amalgamation of *Procoptodon* with *Sthenurus* is demanded by their verisimilitude of tooth sculpture, and by the occurrence of forms of transition between the two. Owen's reference of the maxilla of *Protemnodon anak* to *S. atlas* has been accounted for by Mr. Lydekker (*l.c.* p. 231).

Lower permanent premolar with an obliquely disrupted lobe forming the posterior moiety of the outer side, the cleft occupied by sinuous and papillary folds. Upper permanent premolar with a broad ledge on the inner side, its cavity traversed by erect folds. Molars short, with ascending tapering, spreading folds incumbent on their surfaces; posterior basal margins tumid but rarely forming distinct talons, mandibular symphysis generally anchylosed; lower incisors generally small, laterally compressed and much less incumbent than in other Macropods. A vascular foramen on the outer side of the mandible beneath one of the posterior molars. Posterior orifice of dental canal generally above the level of the teeth. Palate with large vacuities.

The vascular orifice is in *S. goliath* frequently minute, penetrating the bone at the end of a delicate superficial groove; occasionally in this species it appears to be obsolete. Outside the genera *Palorchestes* and *Sthenurus* it has been observed in but two instances, in one *Macropus* and in one *Halmaturus*.

Key to the species.

- Longitudinal links of molars elevated, with lateral processes.
- Cheek-teeth from 82·5 upwards; hinder surface of molars with few but strong vertical folds *goliah*
- Cheek-teeth from 76·0 downwards; hinder surface of molars with numerous fine vertical ridges *otuel*
- Longitudinal links of molars nearly or quite obsolete.
- Length of first three cheek-teeth 55·0; links rudimentary; incumbent folds strong and numerous *pales*
- Length of first three cheek-teeth from 42·0 downwards; links feeble; incumbent folds feeble.
- Incisor elevated, compressed; symphysis ankylosed; mandible thick..... *orca*
- Incisor procumbent, spatulate; symphysis lax; mandible slender *atlas*

STHENURUS GOLIAH, Owen.

Procoptodon goliah, Ow.; Owen, **XXIII.** p. 59; Lydekker, **IV.** p. 234.

P. rapha, Ow.; Owen, **I.** 1874, p. 788; Lydekker, **IV.** p. 234; Etheridge, **V.** p. 190.

P. pusio, Ow., *partim*; Owen, **I.** 1874, p. 788; Etheridge, **V.** p. 190.

P. goliath, Etheridge, **V.** p. 190.

Macropus goliah, Owen, **XXIII.** p. 259.

M. rapha, Flower, **IX.** part ii. p. 721.

Molars with thick lobes, rounded angles, subrectilinear crests and (except as to the upper talons) elevated links. Inner aspect of links and lobes with strong folds, the largest and most constant

of them being the outer one on the intero-anterior face of the hind lobe in the lower and intero-posterior face of the fore lobe of the upper teeth. Hinder surface of molars with strong ascending folds, one or two on the lower, two or three on the upper (Pl. xv. figs. 8-9). Upper premolar short with a broad ledge, not extending beyond the posterior three-fifths of its inner side; its cavity traversed by a longitudinal sinuous ridge. Lower premolar subtriangular with a group of sinuous folds within the posterior cleft.

Dimensions.

Mandible.—The entire series of cheek-teeth varies from 82.5 to 93.7 (6); p.⁴, m.¹, m.², m.³ measure 68.0 (1); m.¹, m.², m.³ 53.0 (2); m.¹, m.² 34.2 (1); m.², m.³, m.⁴ from 58.1 to 65.5 (2); m.⁴ 22.2 (1); mp.⁴ 13.4 (1). The premolar is from 12.5 to 14.5 (5). The width of m.³ ranges from 15.0 to 19.8 (10); its length being from 18.4 to 21.5 (10). The anterior depth of the mandible is from 50.0 to 60.0 (7); the posterior depth from 37.0 to 52.5 (6); the thickness from 34.7 to 42.5 (7). The entire length fore and aft is 147.5 (1).

Maxilla.—The molars m.², m.³, m.⁴ measure together 51.5 (1); m.², m.³ from 38.5 to 42.1 (2); p.³, mp.⁴, m.¹, m.² 46.6 (1). An immature premolar has diameters 12.0 × 9.4; the milk premolar is 9.2 in length.

With one exception all these dimensions come well within the allowable limits of range in a species. The width of the teeth differs to an extent which is nearly a third of its minimum; this is sensibly greater than in the three living species which show the greatest latitude in this respect—*M. giganteus*, *H. agilis*, and *H. ruficollis*—but the difference is too small to stand as a lone objection to the fusion of *S. rapha* with *S. goliah*.

Form of teeth.

Mandibular.—P.⁴ (Pl. xv. fig. 7.) Generally triangular, with rounded sides and angles, rarely an irregular suboval. Outer surface of crown impressed at its anterior two-fifths or thereabouts,

the hinder with a narrow groove near the inner angle. In the young tooth the impression and groove are the terminal limits of an oblique superficial cleft separating the extero-posterior angle from the rest of the tooth, which cleft is traversed and beset by enamel folds and processes; in teeth reduced to a horizontal surface these processes appear in section as a group of sinuous folds occupying most of the centre of the hinder portion of the tooth, and surrounded on the outer side by a long crescentic band of dentine. Diameters 12.7×11.1 .

Molars.—(Pl. xv. fig. 9). The edge of the anterior talon is on the inner side double. From the inner side of both links low vertical folds descend to the valleys. Two or three strong vertical folds project from each face of the inner half of the fore lobe, a single fold from the anterior face of the hind lobe; a strong tapering fold rises upon the centre of the posterior surface of that lobe. The links are lofty and sharp.

Maxillary.—P.⁴ (Pl. xv. fig. 6). Extracted from its crypt in a forward stage of growth is irregular oblong, with convex angles, diameters 11.9×9.0 . Outer side nearly straight, inner with a deep impression at its anterior two-fifths. Fore end sloping, with oblique folds. Intero-posterior region of crown much dilated, its surface depressed, concave; its edges at each end rising upon the side of the main lobe, and its posterior surface separated from that of the lobe by a wide cleft which does not descend to the base. The concavity of the ledge is traversed longitudinally by a single sinuous ridge-like fold. On the hinder half of the outer side of the crown tapering ridges ascend to the crest.

P.³ (Pl. xv. fig. 5) much mutilated and worn down to a field of dentine surrounding a patch of enamel, on the surface of which sinuous enamel folds still appear in section. The inner side of the crown is impressed at its anterior fourth. Diameters 8.5×8.5 .

Rise and fall of teeth.

On this point the limited number of specimens afford sparse information. In the upper jaw the penultimate molar appears to

assume its full functions with the change of the premolars. In the lower the permanent premolar wears down rapidly during the earlier part of its career; all its asperities have disappeared before the hind lobe of m.⁴ is affected by use. Masticatory work is afterwards done principally by the posterior grinders, as the premolar is but little more reduced in height, though the last molar is that of an aged individual.

Examples—twenty-two.

Mandibular.—The associated rami of a mandible with all the cheek-teeth perfect, the incisors and left ascending process wanting; adult—An adult left ramus with all the cheek-teeth perfect, vascular orifice minute—Alveolar region of a left ramus with all the cheek-teeth, several of them imperfect; aged—Two right rami with all the cheek-teeth perfect; foramen small; adolescent—Cast of a right ramus with all the cheek-teeth but p.⁴, some imperfect; vascular orifice moderate; adult—A left ramus with all the molars and the fangs of the premolar; foramen small; adult—A left ramus with the first three molars well preserved; foramen small; adult—A right ramus with part of the ascending process and the last three molars; foramen large; aged—Cast of a portion of a left ramus with m.³, m.⁴ well preserved; the originals of this and 10223 being in the Australian Museum—Alveolar portion of a right ramus with the first three molars and fangs of the premolar; foramen small; adult—Fragment of a right ramus with the last two molars and the premolar well preserved; adult—Fragment of a left ramus with part of m.⁴; adult—Fragment of a right ramus with m.⁴ (10518); adult—An isolated tooth m.² (11118); adult—Outer wall of hinder half of a left ramus (A. 9454).

Maxillary.—A left maxilla with the jugal process and the teeth m.³, m.², m.¹ (part) and fangs of p.⁴; no trace of palatal process (10224); adult—A left maxilla with jugal process and the teeth m.², m.³; no palatal process (10529); adult—Part of a right maxilla with the last three molars; no palatal process (10595);

adult—A right maxilla with jugal process and teeth p.³, mp.⁴, m.¹, m.²; p.⁴ (extracted); palatal vacuity commencing at mp.⁴ (11120); young.

STHENURUS OTUEL, Owen.

Procoptodon otuel, Owen, I. 1874, p. 784; Lydekker, IV. p. 236.

Procoptodon pusio, Owen, *partim*; Owen, II. p. 455.

Pachysiagon otuel, Owen, I. 1874, p. 784.

Lower molars with numerous attenuated ridges on the posterior surface; otherwise not differing from those of *S. goliah* in structure, but inferior in size. Lower premolar elongate-ovate with one or two oblique folds within the cleft.

Dimensions.

Mandibular.—The length of the full series of cheek-teeth varies from 65·5 to 76·0 (5); m.², m.³, m.⁴ measure 51·0 (bis); m.¹, m.² 34·2; mp.⁴ 13·4. The premolar is from 9·3 to 9·9 (2). The width of m.³ ranges from 12·0 to 14·4. The anterior depth of the mandible is from 38·5 to 41·5 (2); its thickness from 28·6 to 32·5 (5). The diastema is 36·6 (1), the symphysis 65·6 (1).

The differences between the mean dimensions in this species and *S. goliah* afford in themselves no good reason for keeping them apart; they are all easily paralleled in modern species; but the difference between the greatest width of the teeth in *S. goliah* and the least in *S. otuel* is much greater than in any recent Macropod, and on this dimensional ground the present species would safely rest were the structural modifications exhibited by it less weighty than they are.

Form.

Mandibular.—In the molars the longitudinal links and vertical processes subsidiary to them do not specifically differ in number or disposition from those of *S. goliah*; the slender ridges wrinkling the hinder surfaces sometimes tend to fuse towards the middle of the base into a short rib.

The lower premolar (Pl. xvi. fig. 1) before eruption simulates remarkably well the ledged upper tooth in several Macropods. The intero-posterior ledge-like cusp occupying half of the outer side is separated from the lobe posteriorly by a wide cleft, but within which a larger and a smaller oblique fold ascend on the inner side of the cusp; anteriorly the cusp joins the lobe by the incurving of its sharp edge, and anterior to this transverse septiment are two cavities separated by a deep rib which ascending to the crest meets a corresponding one on the inner side of the crown, and with it forms a pronounced denticle on the crest. In the worn tooth (Pl. xvi. fig. 4) the structure is still recognisable.

Examples—eleven.

Mandibular.—An adolescent right ramus with all the cheek-teeth and with the incisor nearly entire (11126); accessory processes well marked—A right ramus with all the cheek-teeth but p.⁴ perfect (11119); remains of the accessory processes distinct; aged—The associated rami of an aging mandible (8876), with the greater part of the ascending limbs; accessory processes as before—Portion of a right ramus with the last three molars (8873), adolescent—Alveolar portion of a right ramus with all the teeth mutilated but m.¹, m.² (10409); processes nearly obsolete from wear; aged—Portion of a right ramus with the last three molars (10597); processes very distinct; adult—An adolescent right ramus with incisor and all the cheek-teeth but m.⁴, which has been broken off (11132); processes as before—A right ramus from a suckler with mp.⁴ and m.² in its crypt; the exposed socket of the incisor showing that it was procumbent (10226); the processes on mp.⁴ well marked—Fragment of a left ramus with m.², m.¹, and part of m.⁴ (10596); processes as before; young—Both rami of an aged example all the teeth absent but the last three molars of the left side (11306).

STHENURUS PALES, n.s.

Longitudinal links reduced to a tumescence on the floor of the mid valley and adjacent base of the fore lobe. Posterior basal

rim forming a rather distinct talon with a rudimentary link rising upon the lobe. Incumbent folds on the face of the lobes well marked. Ledge of upper premolar distinct and continuous fore and aft, a subsidiary cusp on the hinder end of the outer side of the crown. Size large, about equal to that of *S. goliah*.

Dimensions.

Mandibular.—The first three true molars are together 56.0 in length; the premolar 18.0. The width of m.³ is 18.0. The thickness of the mandible is not less than 27.5.

Maxillary.—The premolar is 21.0 × 14.1 in one example; 19.6 × 15.0 in other.

Form of teeth.

Mandibular.—P.⁴ (Pl. xv. fig. 3). Elongate-ovate, diameters 18.0 × 8.2, structurally similar to that of *S. goliah*, but differing from it in form and size, and in the latter character agreeing with the upper premolar (10214 the type of the species). On the inner surface of the crown of this tooth are six distinct ribs, five of which form denticulations on the crest; these are not present in *S. goliah*.

Molars.—(Pl. xv. fig. 1). The lobes of the molars are remarkably thin and flat or even a little concave on the posterior surface their crests perfectly straight and their angles sharp. The incumbent folds are much the more numerous on the anterior lobes, the outermost of them being the largest and forming by its repetition a regular series in the line of the teeth. The hinder surfaces of the lobes are faintly sculptured into numerous obscure folds. In size the molars agree with those of *S. goliah*.

Maxillary.—P.⁴ (Pl. xv. fig. 2). Elongate-ovate with the angles rounded and tumid; diameters 22.0 × 15.0. Crest central; mesial region of outer side of crown with a few vertical ribs. Inner side of crown a rectangular ledge from end to end connected with the lobe by numerous transverse ribs. To the end of the outer side of the crown is attached, as in the deciduous tooth of

M. giganteus, a distinct cusp separated from the lobe before and behind by clefts, but connected with it by an apical link.

Examples—four.

Mandibular.—The alveolar longitudinal moiety of a right ramus with the first three molars, of which each is somewhat imperfect, and the core of the premolar (8868); the vascular foramen is well marked; the portion of the socket of the incisor preserved is directed upwards at an angle of about 45° —A left premolar (10216); unworn.

Maxillary.—A left premolar (10214), unworn—A second example (10215); shorter and subtriangular rather than ovate, a little worn but well characterised.

STHENURUS OREAS, n.s.

Longitudinal links of lower molars low but distinct, continuous with the outermost of the incumbent folds which are fewer than, but as broad as, in *S. pales*; posterior basal rim bulging but not forming a talon. *Mandible* thick, symphysis ankylosed, incisor highly inclined, posterior dental orifice level with the teeth. *Upper molars* with rudimentary mid links continuous with the innermost and largest of the incumbent folds which resemble those of the lower teeth but are on each face of the lobes; outer mid valley closed by a marginal fold proceeding from the outer end of each lobe (Pl. xvi. fig. 8). Upper premolar very like that of *S. pales*, but wants the subsidiary cusp.

Dimensions.

Mandibular.—The full series of cheek-teeth is 62·2 in length (1); the entire molar series 58·0 (1); the first three molars 41·5 (1); m.³ 14·6 (1); the premolar 11·9 (2). The width of m.³ is from 12·1 to 13·2 (4). The anterior depth of the mandible is 34·2, the posterior 35·5, the thickness from 22·5 to 25·8 (2).

Maxillary.—The first three cheek-teeth measure 42·0; the first three true molars 40·2 in length; m.², m.³ from 27·2 to 27·6;

m.³, m.⁴ 30·6; and m.³ 15·5. The width of m.³ is from 12·3 to 13·9 (5).

In dimensions of length this species does not much exceed *S. atlas*, but the thickness of the mandible due to its external convexity, which commences at the incisive outlet, combines with its symphysial ankylosis and the erection of its incisor to connect it with the larger species.

In dental sculpture it is also scarcely to be distinguished from *S. atlas*; yet here again affinity with *S. goliah* and *otuel* is shown by the incumbent fold which represents the anterior link sending a lateral process outwards and downwards.

Examples—nine.

Mandibular.—Associated rami of an adult mandible with all the cheek-teeth (11204); vascular foramen large; type—A left ramus with all the molars, tooth-sculpture not so well marked as in the preceding (8841); adult—Portion of a left ramus with the teeth m.¹, m.², m.³; adult; tooth-sculpture much abraded; vascular foramen large (8830)—Portion of a right ramus with m.³ and part of m.²; adolescent (8842); tooth-sculpture very distinct; vascular foramen large.

Maxillary.—Portion of a right maxilla with the first three molars; tooth-sculpture well marked (10262)—Portion of a left maxilla with m.³, m.⁴ (8055); adult; sculpture abraded—Portion of a right maxilla with m.², m.³ (8046); sculpture almost obliterated—Fragment of a right maxilla with m.³ (8069); adult; sculpture distinct—Portion of a left maxilla with the premolar and m.¹, m.² all in fine condition, and exactly fitting the mandible 11204.

STHENURUS ATLAS, Owen; Owen, **XXII.** ii. p. 359.

Macropus atlas, Owen (*l.c.*).

Protemnodon anak, Owen, *partim*; Owen, **I.** 1874, p. 275.

Dental sculpture nearly as in the preceding species, but the linking fold less distinct in the mid valley. Mandible thin, flat

exteriorly, increasing in depth posteriorly. Lower contour line straight or arched upwards. Incisor proclivous, spatulate. Symphysis lax.

Dimensions.

Mandibular.—The full series of cheek-teeth is from 55.8 to 58.6 in length (2); the first three molars 30.1 to 31.6 (2); the premolar 12.1×6.8 to 12.8×7 (2). The width of $m.^3$ is from 8.9 to 10.5. The anterior depth is from 26.1 to 28.5 (4); the posterior from 29.0 to 32.7 (4); the thickness from 14.8 to 15.6 (4).

Form.

Mandibular.— $P.^3$ (Pl. xvi. fig. 9). This tooth as exemplified by the anterior two-thirds of its crown in a mandibular fragment is structurally similar to its successor $p.^4$, but the extero-posterior complicated region of the crown is not evidently marked off by an oblique cleft. On the outer surface of this region there is a distinct trace of an outstanding cusp corresponding to that in $p.^4$ of *S. pales*.

Molars.—Mr. Lydekker's statement that in *Sthenurus* there are no "vertical folds" must be understood to refer only to the lateral processes of the longitudinal links, as the latter exist in *S. goliath* and *S. otuel*. Of the presence in the type of the genus of tapering folds lying upon the anterior surface of the lobes as we have seen them in all the species now referred to it there is no doubt; there is indeed evidence of the fact in the figure of $m.^3$ in II. Pl. 82, fig. 9, though no mention of it is made by Owen. In the mutilated tooth now figured (Pl. xvi. fig. 11) from a mandible having the characteristic premolar rising into place the incumbent folds are well marked fully in the hind lobe and by their bases in the broken fore lobe.*

* Complication of structure is more frequently found in the anterior molars than in the posterior; nay, even the fore lobe of the last molar rather than in the hind. It is therefore unsafe to pronounce teeth free from folds unless the young jaw is found without them, or to neglect the slightest trace of such folds which may remain in worn teeth.

Examples—five.

Mandibular.—A left ramus with all the cheek-teeth in place; incumbent folds on m.⁴ distinct, on the other teeth almost obliterated by old age (10607); vascular foramen large—A left ramus with all the cheek-teeth (10726); distinct relics of the folds on the posterior molars; vascular orifice large; aging—A right ramus with the first three molars, sockets of p.⁴ and m.⁴; folds distinct on all the teeth (8831); vascular orifice large; adolescent—A left ramus with all the cheek-teeth but the last; the rising premolar exposed (10233); vascular orifice moderate; young—A fragment of a left ramus with the anterior portion of the milk premolar.

Key to fossil Halmaturi.

Width of $\overline{m}^3$ 7·6 and upwards.

$\overline{P}^4$ with a large intero-posterior dilatation; lobes
with folds *vincens*

$\overline{P}^4$ with no large intero-posterior dilatation

Crown of p.⁴ with an anterior lobe partially
divided off..... *thor*

Crown of p.⁴ without anterior lobe partially
divided off

Size larger; length of m.¹, m.², m.³ 32·0 or up-
wards..... *anak*

Size smaller; length of m.¹, m.², m.³ 23·5

Intero-anterior surfaces of lobes smooth..... *dryas*

Intero-anterior surfaces of lobes with ac-
cessory processes..... *odin*

Width of $\overline{m}^3$ 6·5 or less.

$\overline{P}^4$ with a large intero-posterior cusp; crests of
molars straight *indra*

$\overline{P}^4$ with a smaller intero-posterior cusp; fore
valley of anterior molars with an accessory
link..... *siva*

P.⁴ with no large intero-posterior cusp.

Molar crests rectilinear, with sharp angles and feeble links *vishnu*

Molar crests curvilinear, with rounded angles and strong links..... *cooperi*

N.B.—As the lower jaw of *H. minor*, Ow., is unknown, its place in the above scheme remains to be ascertained.

HALMATURUS VINCEUS, n.s.

Upper molars with a group of tapering folds in relief on the extero-posterior face of each lobe, with the fore link nearly or quite obsolete and the mid link feeble. Lower molars with a vertical plate and folds in relief on the intero-anterior face of the lobes and with a posterior basal protuberance which is sometimes a distinct talon. Upper premolar broadly ledged posteriorly, narrowly in front. Lower premolar cuneiform in front much dilated intero-posteriorly, J-shaped.

Dimensions.

Mandibular.—In adults the entire series of cheek-teeth ranges in length from 58 to 64.1 (5); the first four 45.3 (1); the first three from 29.5 to 31.8; the first two 20.6 (1). The premolar from 11.0 to 15.6 (8); the last four molars from 48.5 to 49.4 (3); the last three from 34.0 to 38.0 (3); the last two from 25.5 to 29.8 (3); m.⁴ from 13.1 to 14.5 (2); m.¹, m.², m.³ from 26.2 to 34.0 (3); m.¹, m.² 23.2 (1); m.¹ from 10.7 to 11.2 (2); m.² from 12.4 to 13.1 (3); m.², m.³ from 23.7 to 25.6. The width of m.³ is from 9.8 to 13.0 (31).

In young, p.³, m.¹, m.², m.³ measure from 38.0 to 42.0; mp.⁴, m.¹, m.² from 32.5 to 33.0; m.³ from 13.0 to 15.5 (5).

The anterior depth of the mandible varies from 22.5 to 32.6 (13); the posterior from 21.0 to 32.4 (17); the thickness from 15.1 to 25.0 (23).

Maxillary.—The length of the full series of cheek-teeth is from 60.0 to 64.2 (3); of the first three 37.5 (1); of the true molars 47.5 (1); of the last three molars from 31.9 to 37.0.

Though the lower teeth are in proportion to the upper unusually broad, being scarcely a tenth narrower, the presence of similar accessory processes on corresponding parts of the masticatory surfaces assures us that in this instance molars of the upper and lower jaws are correctly referred one to the other.

Form.

Maxillary.—P.⁴ in the maiden state unknown. The worn tooth (Pl. xvi. fig. 12) is irregularly subtriangular, attenuated at the fore end, its ledge much dilated posteriorly, but narrow at its anterior junction with the lobe, and without traces of transverse ridges. Crest subcentral in front, over exterior fourth behind. Mesial three-fifths of outer surface impressed, deeply at its posterior end: impressed surface with about four low vertical ribs; inner surface with traces of numerous narrow vertical ribs. On the intero-posterior angle remains of a cusp. Diameters 14.7 : 7.6; 13.4 : 7.6. The tooth is equal in length to m.⁴.

P.³ unknown.

Molars.—(Pl. xvi. fig. 14). With one or more short broad flame-like folds on the posterior face of each lobe within the hollow triangle contained by the descending edges of the lobe; not infrequently the folds become plates which running together enclose the lower part of the inner half of the triangular space. The hind lobe of m.⁴ has no distinct processes. Traces of the folds are persistent in well worn teeth with varying distinctness.

Mandibular.—P.⁴ (Pl. xvi. fig. 13) elongate, narrow anteriorly, suddenly widening posteriorly; mesial diameters 11.5 × 4.3; 11.0 × 4.0; 11.1 × 5.4. Crest central, posteriorly curving downwards to the intero-posterior angle. Outer side of crown straight or slightly convex, with a more or less distinct mesial impression bearing about three vertical ribs; inner side conchoidal posteriorly with three strong ribs; anterior cusp more or less expanded and well defined.

P.³ is irregular, subelongate, tapering slowly to a pointed fore end. Crest on the inner side anteriorly, on the outer

posteriorly, where it makes an open curve to the apex of a large intero-posterior cusp; outer surface of crown with a short impression faintly marking the limit of an anterior cusp; inner surface concave longitudinally, with two or three moderately strong ribs; in one example a deep depression between the extero-posterior angle of the lobe and its crest demarcating a sort of basal talon. Diameters 8·4 : 4·0.

Molars.—(Pl. xvi. fig. 15). At the point in which each obliquely descending revolute edge of a lobe becomes a longitudinal link there are one or two more or less compressed processes rising within the inner side of the link; these either ascend upon the face of the lobe or stand out from it, and sometimes by confluence and extension upward and inward simulate on that side the oblique edge of the other side. These or traces of them are constant whenever the tooth is not too far gone in wear. The posterior talonal protuberance is also constant and occasionally rises obliquely on to the base of the inner side of the tooth.

Rise and fall of teeth.

No precise information as to the relative periods of change of teeth can be gathered from the examples at present available for study.

Examples—seventy-six.

Mandibular.—Of adults: Five rami with the full series of cheek-teeth—Thirty-five rami or portions thereof with teeth in greater or less number. Of young: Four rami with p.³ and three following teeth—Eight without the deciduous premolar.

Maxillary.—Three maxillæ with all the cheek-teeth—One with all the true molars—Five with sundry teeth and a young maxilla with mp.⁴, m.¹, m.². Of fourteen supplementary—all are clearly identifiable by the characters peculiar to the species.

HALMATURUS THOR, n.s.

Molars with crests subrectilinear, lobes moderately thick, angles rather rounded and links feeble.

Lower premolar elongate, bicuspidate, without intero-posterior cusp. Molars smooth or with accessory plates, without posterior groove or basal talon. Lower contour line of mandible a gentle curve throughout.

Dimensions.

Mandibular.—The full series of true molars is 39·0 in length when aged .1); the first four cheek-teeth measure 38·0 (1); the first three 28·6 (1); the last three 30·5 (1); the last two 22·5 and 23·5 (2). The premolar 7·5 and 8·0 (2). The width of m.³ is from 7·7 to 8·4 (6). The anterior depth is from 20·2 to 23·5 (4); the posterior from 18·4 to 22·0 (5); the thickness from 10·1 (aged) to 14·1 (5). The external length is 92·0; the internal 72·0.

Though the thickness of the mandible has the same range as in *H. agilis*, which of modern wallabies has the stoutest underjaw, its length and depth are comparable with those of the kangaroos only. This is also the case with the length of the cheek-teeth, which may be estimated at 50·0 in young adults, and with the width of the molars, but from the kangaroos it is at once distinguished by the structure both of premolar and molars.

Form.

Mandibular.—P.⁴ (Pl. xvii. fig. 1) elongate, narrow, diameters 8·0 × 3·4, bicuspid; crest a little to the inner side, deeply notched at its anterior two-fifths. Anterior cusp a well defined strongly compressed cone separated from the longer posterior part of the lobe by a deep groove descending upon each side of the crown nearly to the base and by the notch in the crest; a slight incrasation of the crown over the intero-posterior angle does not affect the general parallelism of the sides. Equal in length to m.¹.

Molars.—(Pl. xvii. fig. 2). These show a tendency to develop a single erect compressed process at the bottom of the inner mid valley—*i.e.*, a rudiment of an accessory link similar to that in the upper teeth of *Palorchestes* and *M. pan (infra)*. This process occurs in two examples.

Rise and fall of teeth.

The permanent premolar has risen to the crowns of its predecessors as the fore lobe of m.⁴ has pierced the gum, the hind lobe of m.³, having then its edge bevelled off by wear; but it may be also fully in place and distinctly worn at an earlier period, in which the hind lobe of m.³ is almost untouched by wear. It remains in function at least till the last molar is well worn down.

Examples—nine.

Mandibular.—An adolescent right ramus with the first four cheek-teeth—An aged left ramus with base of incisor and the posterior true molars—An adult right ramus with all the true molars, m.¹ worn to the base—An adult right ramus with the last three molars in fine preservation—An adolescent right ramus with the last two molars well preserved—A right adolescent ramus with the first three true molars and p.⁴ exposed from above in its crypt, and fragments of a right adolescent ramus with the first three cheek-teeth.

The species is well characterised by the form of its premolar in conjunction with a size superior to that of modern wallabies.

HALMATURUS ANAK, Owen, VI. Vol. xv. p. 185, 1859

Protomnodon anak, Owen, *partim*, I. 1874, p. 275.

P. og, Owen, I. 1874, p. 377.

P. ræchus, Owen, I. 1874, p. 281.

P. mimas, Owen, I. 1874, p. 278.

P. antæus, Owen, I. II. p. 448.

Sthenurus atlas, Owen, *partim*, I. 1874, p. 265.

S. brehus, Owen, I. 1874, p. 272.

Macropus mimas, Flower, IX. pt. 2, p. 720.

M. brehus, Lydekker, IV. p. 207.

M. ræchus, Owen, I. 1874, p. 281; Lydekker, IV. p. 212.

M. anak, Lydekker, IV. 214.

Molars smooth, with rectilinear crests, feeble links and sharp angles; upper molars without distinct anterior links, lower seldom without posterior talons. Premolars about as long as the lower last molar. Upper premolar with a long transversely ribbed ledge; lower without intero-posterior cusp.

Dimensions.

Mandibular.—In adults: The length of the full series of cheek-teeth ranges from 60.2 to 82.3 (34); of the first four from 48.2 to 60.0 (16); of the first three from 32.1 to 41.2 (10); of the first two from 22.2 to 27.4 (7); of the premolar from 14.0 to 18.2 (74); of the last four molars from 48.2 to 56.0 (11); of the last three from 40.3 to 53.0 (16); of the last two from 26.5 to 33.7 (19); of $m.^4$ from 14.5 to 19.0 (9); of $m.^1$, $m.^2$, $m.^3$ from 37.0 to 45.6 (7); of $m.^1$, $m.^2$ from 21.5 to 28.6 (16); of $m.^2$, $m.^3$ from 25.4 to 31.0 (14); of $m.^1$ from 9.2 to 13.3 (9); of $m.^2$ from 12.5 to 18.3 (11); of $m.^3$ from 12.2 to 15.0 (5).

In young: The length of $p.^3$, $mp.^4$, $m.^1$, $m.^2$, $m.^3$ is from 54.1 to 62.2 (3); of $p.^3$, $mp.^4$, $m.^1$, $m.^2$ from 42.0 to 51.0 (7); of $p.^3$, $mp.^4$, $m.^1$ from 28.4 to 32.8 (5); of $p.^3$, $mp.^4$ from 18.0 to 20.9 (7); of $p.^3$ from 8.5 to 11.2 (23); of $mp.^4$, $m.^1$, $m.^2$, $m.^3$ 57.8 (1); of $mp.^4$, $m.^1$, $m.^2$ from 33.6 to 35.2 (4); of $mp.^4$, $m.^1$ from 20.0 to 23.5 (10); of $mp.^4$ 10.2 (1).

The width of $m.^3$ in adults is from 10.0 to 13.6 (118). The anterior depth of the mandible is from 22.0 to 45.0 (82); of the posterior from 18.0 to 40.4 (72); the thickness from 13.6 to 23.5 (89); the external length is from 100.0 to 155.0 (13); the internal from 67.5 to 113.5 (11); the symphysis from 32.5 to 57.0 (15); the diastema from 31.1 to 57.0 (15).

Maxillary.—In adults: The length of the entire series of cheek-teeth is from 65.1 to 85.5 (17); of the first four 66.5 (1); of the first three from 38.5 to 45.5; of the first two from 24.6 to 27.1 (3); of the premolar from 14.4 to 20.4 (33); of the last four molars from 50.5 to 67.5 (8); of the last three from 40.0 to 51.5 (12); of the last two from 30.1 to 37.0 (9); of the first three true molars

from 33.1 to 39.9 (5); of the first two from 21.5 to 27.4 (7); of m.², m.³ from 28.0 to 34.1 (11); of m.² 17 (1); of m.³ from 17.0 to 18.4 (6); and of m.⁴ 16.6 (1). The breadth of the palate is from 66.0 to 68.5 (2).

In young: p.³, mp.⁴, m.¹ range from 28.6 to 37.0 (3); mp.⁴, m.¹, m.² 41.7 to 44.4.

The proportionate mean widths of m.³ above and below are 11.8 and 13.6.

The degree of variation in the length of the cheek-teeth found in this species is less than that shown by *H. ruficollis*; and the premolar has a more restricted range of length than in most of the larger existing wallabies. On the other hand, the width of the teeth and the depth of the mandible have a somewhat greater range of measurement than in living species, and in thickness the ramus is decidedly more variable. But as in all the dimensions, the extremes are reached by insensible gradations, excess even in the width of the teeth must be considered a peculiarity of the species and one probably related to its inordinate vigour as shewn in its fecundity. It is quite the most abundant Macropod of its period.

As no one of the several species added by Owen to the type of his genus *Protemnodon* has a distinctive character other than a supposed differentiation in size, Lydekker has taken a step in the right direction in reducing their number to three—*brehus*, *ræchus* and *anak*. With a fuller supply of material he would no doubt have felt perfectly safe in referring all the fossils of the *Protemnodont* series to the single species *anak*. The essential unity of the species is shown not merely by graduation of difference affecting each part of each of three hundred and thirty individuals alike, but by that disproportionate difference between the parts which renders it impossible to lay down interspecific lines of demarcation anywhere. Detailed measurements of thirty-four entire mandibles of *brehus*, *ræchus* and *anak*, and a careful comparison of their differences with those observed in the measurement of recent species fail to show that there is any sufficient reason for regarding them as distinct species. Constant differences of form there are none.

Form.

Mandibular.—P.⁴ (Pl. xvii. fig. 6) as it appears in a worn condition is elongate with mesial diameters 178:56, oblong tectiform, obtusely pointed in front and not dilated posteriorly. Crest central, nearly level, obtusely serrated. The mesial two-thirds of the crown compressed, but more deeply on the outer side, the surface of which has corrugations with much fainter ribs in the intervals; the inner surface similarly corrugated. Anterior cusp distinctly defined by the mesial compression, its point low and obtuse. Over the intero-posterior angle the crown is more tumid than over the outer angle.

The tooth varies much in proportions and other respects. The diameters may become 161:72 and the intero-posterior part of the crown so tumid as to cause the inner surface of the crown to be concave longitudinally, the tooth being then distinctly broader at its hinder end. The number, strength and disposition of the corrugations are all subject to variation, and frequently under stress of wear disappear altogether.

P.³ (Pl. xvii. fig. 5) in its maiden state is irregularly oblong, with mesial diameters 103:51; its basal contour is arched on the outer side, nearly straight on the inner, its fore end obtusely pointed. Crest with five low obtuse cusps, subcentral, curving on to the intero-posterior angle, which is sufficiently tumid to render the crown vertically concave on that side. Crown compressed, with three ribs on the outer and two on the inner side, the outer ribs graduated in length posteriorly. Anterior cusp moderately distinct.

This tooth also varies in shape, proportions and corrugation. The intero-posterior angle may dilate sufficiently to render the general form subtriangular, the mesial diameters may vary to 106:66, 89:86, the ribs may be fewer in number or become indefinite. Under wear the ribs quickly vanish.

Molars.—(Pl. xvii. fig. 9). The longitudinal linking ridges are weak, the lobes but lightly convex posteriorly. Posterior basal talons are generally present as erect plates, raised rims or a

mere, but decided, bulging of the base. The hind lobe of m^4 is in the mean of ten examples narrower than the fore lobe in the ratio 11 : 12.

The contour of the mandible forward of the hinder molars is nearly straight. The upward curve beneath the anterior molars, always faint, is occasionally reversed and a continuous curve produced from the inflected angle to the symphysis.

Maxillary.— $P.^4$ (Pl. xvii. fig. 8). In a tooth recently come into position the general form is an isosceles triangle with the inner side irregular and the angles rounded. Diameters 191 : 100. Crest subcentral, parallel with the outer side of the base. Mesial two-fifths of the outer side of the crown deeply impressed, with three strong vertical folds rising to the crest. Ledge occupying mesial two-thirds of the inner side of the crown, with a raised basal rim commencing at the hinder end of the anterior cusp; within the rim the ledge is deeply concave and is traversed by four ribs ascending on the lobe to the crest. Intero-posterior cusp wide, joined to the side of the lobe; behind it to the outer side a deep transversely elongate pit, which is enclosed behind by the posterior surface of the lobe.

By contraction of the intero-posterior cusp the form may become regularly oblong, the tooth being then scarcely broader behind and its diameter 178 : 75, or the like form may result from a dilatation of the fore end of the basal rim to an equality with the extent of the intero-posterior angle; the tooth in this case may present a gibbosity near the fore end of the inner side. The ribs of the outer side of the crown may be reduced to two in number. The basal rim of the inner side is generally broken up into from two to five tubercles, usually one at the base of each vertical rib.

$P.^3$ (Pl. xvii. fig. 7) in a fresh condition is irregularly sub-triangular, with the fore end rounded. Mesial diameter 133 : 77. Crest well to the outer side of the central line, parallel with the outer side of the base. Mesial half of the outer side of the crown impressed, with two strong vertical folds. Ledge as in $p.^4$ but gradually dilating as it nears the intero-posterior cusp, which is

wide, joined by a rib to the lobe and separated from it posteriorly by a deep excavation. In a much worn tooth the basal rim may be almost entire and the diameters 125:76.

Molars.—(Pl. xvii. fig. 10). Fore link obsolete or nearly so, and mid link weak; lobes but slightly convex anteriorly. The base of the posterior concavity of m.⁴ is enclosed by the descending inner edge; an adpressed fold is therefore seen on the hinder surface of the anterior molars. The difference between the widths of the lobes of m.⁴ is greater than in the lower tooth; their ratio is 13·5 to 12·5.

Examples—three hundred and twenty-nine.

Mandibular.—Of adults: Thirty-four rami with all the cheek-teeth, most of them with the incisor in place—One hundred and fifty-three rami or parts thereof with fewer than all the cheek-teeth.

Of young: Twenty-four rami with p.³ and some of the following teeth—Sixteen rami without p.³.

Maxillary.—Of adults: Seventeen maxillæ with all the cheek-teeth, five of them being each a part of a cranium more or less entire—Seventy-six maxillæ or parts thereof with teeth in greater or less number.

Of young: Nine maxillæ with various teeth.

HALMATURUS DRYAS, n.s.

Molars with the upper fore link well developed. Upper premolar with a narrow ledge tubercular, but not transversely ribbed. Lower premolars, both permanent and deciduous, like those of *H. anak*. Size inferior.

Dimensions.

Type maxillary.

Maxillary.—In adults: The length of the entire series of cheek-teeth is 54·9 (1); of the first four 46·2 (1); of the true molar series 47·5 (1); of the first three 29·6 (1); of the premolar from 11·5 to 15·0 (3). The width of m.³ is from 9·9 to 10·3 (5).

Mandibular.—In adults: The full series of cheek-teeth ranges from 52·7 to 58·5 (3); the first four are 35·5 (1); the first three

vary from 28·3 to 29·1 (3); the first two are 19·5 (1); the premolar measures from 10·0 to 13·0 (8). The true molar series ranges from 40·0 to 48·1 (8); the last three from 34·3 to 41·1 (9); the last two from 23·8 to 28·6 (12); the first three from 29·4 to 38·1 (5); the first two from 20·5 to 22·6 (4); $m.^2$, $m.^3$ are 27·1 (1); $m.^3$ 13·0 (1); $m.^4$ is from 13·2 to 14·4 (7). The width of $m.^3$ is from 8·0 to 10·5 (37). The anterior depth of the mandible varies from 22·0 to 30·0 (20); the posterior from 19·4 to 29·9 (21); the thickness from 12·7 to 18·8 (31).

It will be apparent from these measurements that though their maxima overlap in some cases the minima of *H. anak* the differences between their minima and the maxima of the other are far too great to be ascribed to the elasticity of a single species even were all the teeth indistinguishable. The existence of a dwarfed variety of *H. anak* conterminous and contemporaneous with it is too unlikely to be worth considering.

The probability that upper and lower jaws are in this case rightly associated rests on the grounds of corresponding size and premolar structure.

Form.

Mandibular.—The premolar $p.^4$ (Pl. xvii. fig. 12) as extracted from its chamber in an advanced stage of growth is an elongate-ovate symmetrical tooth with a cuneiform crown and diameters 10·7 : 4·4. The crown is compressed as to its mesial two-thirds, more deeply on the inner side. Three mesial ribs on each side form serrations on the crest which is central. There is no dilatation or tumidity of the intero-posterior angle, but the end of the crest inclines slightly inwards. In the worn state these teeth can be distinguished from old teeth of *H. anak* only by their size.

The deciduous premolar $p.^3$ (Pl. xvii. fig. 11) is very similar to that of *H. anak*, convex on the outer, nearly straight on the inner side, with a slightly developed intero-posterior cusp which renders the inner side somewhat concave posteriorly. Diameters 7·0 × 3·9.

Maxillary.—The premolar $p.^4$ (Pl. xvii. fig. 13) is elongate-triangular, with diameters 13 × 7·8 (basal). Crest central

anteriorly, parallel with outer side and not incurved posteriorly. A largely dilated intero-posterior cusp linked to the lobe apically, separated from it by a wide cleft posteriorly. Ledge very narrow within a broadly tubercular basal rim which extends to the anterior fifth. Mesial two-thirds of the outer side impressed, with three strong short ribs, decreasing in length rearwards.

Molars.—(Pl. xvii. figs. 14-15). Mandibulary, with a narrow basal ridge posteriorly; hind lobe of m.⁴ distinctly the narrower.

Examples—seventy-three.

Maxillary.—Four adults.

Mandibular.—Fifty-six adults, thirteen young.

HALMATURUS ODIN, n.s.

Lower premolar unilobate, mesially corrugated, expanded but not developing a cusp on intero-posterior angle. Molars with an accessory process in relief on intero-anterior surface of lobes and with basal talons. Lower contour line undulated.

Dimensions.

Mandibular.—The full series of cheek-teeth measures 46·7 in length (1); the first four 37·0 (1); the first two true molars 18·6 (1); the last molar 12·4 (1); the premolar from 8·0 to 8·7 (3); m.² 10·8 (1). The width of m.³ 7·6 and 8·1 (2). The anterior depth is from 19·2 to 24·1 (3); the posterior from 16·1 to 23·8 (3); the thickness from 11·5 to 12·5 (3).

Form.

Mandibular.—P.⁴ (Pl. xvii. fig. 16) elongate; diameters 8·0 × 4·0, gradually widening from the pointed fore end. Crest central; anterior and posterior cusps defined by a mesial compression of the crown, which has on each side three distinct and two obscure short ribs. Crest curving on to a small but distinct dilatation of the crown over the intero-posterior angle. Profile of fore end of crown gibbous.

Molars.—(Pl. xvii. fig. 17). From the intero-anterior angle of each lobe a low fold descends obliquely to or towards the middle of the anterior base of the lobe, and on the triangular face of the lobe lies a small ascending fold similar to those in *Sthenurus*. Previous knowledge of these folds is required for the recognition of traces of them left in the aging mandible. The basal talon is a distinct ledge-like protuberance.

Examples—six or eight.

An adolescent right ramus with the first four cheek-teeth, the type—A right aging ramus with all the cheek-teeth—P.⁴ in a fragment of a right adolescent ramus—M.⁴ in a portion of an aged left ramus—Part of an adult left ramus with m.¹, m.²—And a portion of a young left ramus with m.². To these may be added two maxillary fossils which perchance belong to the species.

HALMATURUS INDRA, n.s.

Molars with crests moderately curved, angles subrotund, and links feeble. The lower permanent premolar subtriangular, with a large intero-posterior cusp; the deciduous short, broad, convex exteriorly. Molars smooth, without posterior groove or distinct talon.

Dimensions.

Mandibular.—Young: P.³, mp.⁴ m.¹ measure 23.1; p.³ 6.4; p.⁴ immature 7.7.

The long dimension of the teeth is the same as in *H. cooperi*.

Form.

Mandibular.—P.⁴ (extracted) (Pl. xvii. fig. 19), subtriangular, with a large intero-posterior cusp, separated from the posterior surface of the lobe by a broad vertical groove. Outer surface of crown impressed and bearing a low broad mesial rib; anterior end of crown with a horizontal groove between base and lobe. Crest central, not curving inwards posteriorly.

P.³ (Pl. xvii. fig. 18) short, broad, basal outline biconvex, diameters 6.4 × 4.5. Crest towards the inner and flatter side.

Crown mesially compressed, with a distinct mesial rib on each side. Basal rim on each side tumid, subnodular, especially on outer side, obscurely continuous round fore end.

Molars.—(Pl. xvii. fig. 20). Links high but narrow; on the outer side of the posterior base of m.¹ a rudimentary ledge-like talon.

Sufficiently distinguished by the premolars from all other species recent and extinct.

HALMATURUS SIVA, n.s.

Molars with curved crests, rounded angles and strong links.

Lower premolar unilobate, narrow; intero-posterior dilatation moderate, consisting apparently of two flat folds tapering off above into vertical ribs; anterior cusp small and ill-defined.

Molars smooth, with long anterior talons, and without posterior groove or basal talon. The inner valley of the anterior talon subdivided by an accessory link in the two anterior molars.

Dimensions.

Mandibular.—The full set of adult cheek-teeth is 40·6 in length; the first three molars 24·4 and 24·9; the last three 28·8; the first two 17·2; the premolar 7·1. The width of m.³ is from 6·2 to 6·4 (4). The anterior depth of the mandible is from 18·0 to 23·0 (4); the posterior from 12·9 to 18·1 (4); the thickness from 11·3 to 12·0 (3).

In general size it agrees with the larger wallabies of the present day.

Form.

P.⁴ (Pl. xvii. fig. 21) diameters 7·1 × 2·7; crest over inner edge anteriorly, nearly level, curving inwards posteriorly; anterior cusp scarcely differentiated from the rest of the crown by a slight mesial impression on the inner side; posterior to this the inner side is rendered more concave by two successive folds ending above in sharp plaits.

Molars.—(Pl. xvii. figs. 22-23). The anterior talons are in length nearly a third that of the entire tooth.

Examples—eleven.

A right adult ramus (11181) with all the cheek-teeth but m.¹—A second with all the cheek-teeth older, and a third with all the true molars aged—A left adult ramus with the last three molars—Two rami with the anterior three true molars—A fragment of a ramus with m.¹, m.².—A young ramus with the last three molars, and a second with the last two—A maxilla with the last three molars is also referable to this species.

The type, 11181, could in the absence of the premolar be mistaken without any difficulty for a mandible of *H. agilis*; but in addition to the dental differences apparent on comparing it critically with mandibles of *H. agilis* of the same age, we may add that the diastema is much longer, and the anterior dental foramen further forward than in any example of the recent wallaby.

HALMATURUS VISHNU, n.s.

Molars with rectilinear crests, sharp angles and feeble links.

Lower premolar unilobate, cuneiform, coarsely ribbed. Molars smooth. Anterior portion of lower mandibular contour straight.

Dimensions.

Mandibular.—The length of the full series of cheek-teeth is 44·3; the true molars are from 33·4 to 35·6 in length (3); the last three 28·0; the last two 18·6 and 21·9 (2); the first three 23·5; the first two from 15·1 to 17·4 (4); m.² 9·0; mp.⁴, m.¹, m.² 17·4 and 23·4 (2); the premolar p.⁴ 9·2 and 9·6 (2). The width of m.³ is from 6·5 to 7·6 (8). The anterior depth is from 18·0 to 20·0 (4); the posterior from 15·4 to 16·5 (4); its thickness from 10·1 to 12·2 (7); its internal length 58·0.

The length of the dental series is surpassed by that of the kangaroos only, and is approached most nearly by that of *H. agilis* among the wallabies. In this latter species we find a maximum length of 43·5 with a mean of scarcely 40·0. But from *H. agilis* the extinct species is better distinguished by the length of the premolar, 9·2 minimum against a maximum of 8·1 in the

living species; by the greater width of the molars, that of m.³ averaging 7.1 against 6.4 in *H. agilis*; by its much feebler interlobular links; and by the straightness of the lower edge of the mandible. The same characters serve to separate it from *H. ualabatus*, which approaches it somewhat more nearly in the length of the premolar, but recedes further from it in the total length of the cheek-teeth. With no other recent species is it comparable as to the dimensions of teeth, though in the depth and thickness of the mandible it is occasionally exceeded by all the larger-sized modern wallabies.

Form.

Mandibular.—P.⁴ (Pl. XVII. fig. 3) subelongate, oblong, cuneiform, diameters 9.6 × 4.4, sides parallel, fore end obtusely pointed. Crest a little to the inner side, with obtuse denticulations corresponding to coarse but indistinct corrugations on either side of the mesially compressed crown. A faintly marked nodular basal rim on either side is continuous round the fore end. In a second example with diameters 9.2 × 4.6 the mesial compression of the crown is stronger, and the crest curves slightly over to the interoposterior angle, rendering the inner side of that end of the crown subconchoidal. Length equal to or rather less than that of m.⁴.

Mandible elongate, shallow, nearly straight from the posterior molar forward.

Molars (Pl. XVII. fig. 4) without accessory folds; with or without a rudimentary talon; links narrow and low.

Persistence of teeth.

The permanent premolar though much worn is still in the horizontal line of the molars, and shows no sign of ejection when the last molar has been some time in use; in another instance the roots of the broken tooth are in place, though m.⁴ is much worn.

Examples—sixteen.

These consist of two adult mandibular rami with all the cheek-teeth, the premolar of one of them being imperfect; of three with

all the true molars; nine with sundry molars, and two young rami with mp.⁴, m.¹, m.².

HALMATURUS COOPERI, Ow.

Molars with curved crests, rounded angles and strong links.

Lower premolars elongate, narrow, tumid on intero-posterior angle, but developing there no cusp; crest tridentate. Molars smooth without groove or basal talon posteriorly. Upper premolar ledged, with an intero-posterior cusp; molars smooth with adpressed folds posteriorly. Lower mandibular contour undulatory. Palate entire.

Dimensions.

Mandibular.—The full series of cheek-teeth measures in adults from 38·6 to 42·5 (3); in adolescents from 44·4 to 50·7 (3). The true molars vary from 34·0 to 39·5 (5); m.², m.³, m.⁴ from 28·5 to 33·6 (9), but in an adolescent tooth reach 35·7; m.³, m.⁴ are from 20·5 to 25·0 (7); m.⁴ from 11·8 to 12·8 (4). The first four cheek-teeth range from 29·3 to 37·0 (15); the first three from 29·3 to 38·4 (4). The premolar varies from 7·0 to 9·6 (6). The width of m.³ ranges from 6·5 to 8·5, doubtfully to 9·6 (54). The anterior depth in adults is from 17·5 to 27·3 (17); in adolescents 17·6 to 23·5 (17); the posterior in adults from 17·4 to 26·6 (18); in adolescents from 15·0 to 21·5 (6). The external length is from 65·7 to 78·0 in adults (3). The internal from 53·2 to 66·7 (6); the thickness from 11·4 to 16·2 (23). In the young the first three cheek-teeth are 23·1 and 24·0 (2); mp.⁴, m.¹ 16·0; m.¹ 9·9; m.¹, m.², m.³ 26·6 and 29·5; m.¹, m.² from 17·0 to 21·6 (4); m.², m.³ from 20·0 to 22·8 (5); m.³ from 10·1 to 12·5 (4); p.³ 6·8 and 7·7 (2).

Maxillary.—The entire set of cheek-teeth is 50·2; m.¹, m.² 23·0; m.², m.³ 23·3; and p.⁴ 10·5. Width of m.³ 9·5.

Form.

Mandibular.—P.⁴ (Pl. xvii. fig. 25) irregularly ovate, diameters 8·5 × 3·1; crest subcentral, tridentate. Crown mesially compressed; the compression defining an anterior cusp. Mesial cusp

small, formed by the coincidence of a rib in the middle of the compression on either side. Sides nearly parallel; fore end acuminate; intero-posterior angle a little expanded, but not bearing a distinct cusp. About as long as m.¹.

P.³ (Pl. xvii. fig. 24) diameters 7.4×3.7 , otherwise differing little from p.⁴.

Molars.—(Pl. xvii. fig. 26). Subelongate, diameters of m.³ 11.2×8.0 .

Maxillary.—P.⁴ (Pl. xvii. fig. 28) elongate, pointed anteriorly, diameters 10.5×5.0 . Ledge very narrow, continued to the fore end of the crown; an intero-posterior cusp connected with the lobe apically and separated from it posteriorly by a deep vertical gorge, crest tridentate; outer surface of crown mesially impressed, the impression strongly defining an anterior cusp. Median cusp connected with basal rim of ledge by a vertical rib.

Molars.—(Pl. xvii. fig. 27). Subquadrate; diameters of m.³ 11.5×9.5 ; the posterior hollow of m.⁴ nearly closed in at the base by an elevated lip which on anterior teeth forms the adpressed fold.

Rise and fall of teeth.

Mandibular.—The permanent premolar is ejecting its predecessor just before the hind lobe of m.³ comes into use; it is retained at least till the hind lobe of m.⁴ is half worn down, and its persistence causes m.¹ to be thrust out of the line of the teeth or reduced to a mere shell. As Owen observes, this retention of the anterior cheek-teeth is inconsistent with the dental flux of a true *Macropus*.

Examples—seventy-three.

Mandibular.—Adults thirty-one; adolescents nineteen; young twenty.

Maxillary.—One adult cranium with all the cheek-teeth; two portions of young maxillæ.

This, the most abundant of the species with teeth similar in size and form to those of the type of Owen's *H. cooperi*, is the

most likely to have yielded that fossil, and is identified with it on that account alone; if in error, the fault must lie with the describer of an object not susceptible of sufficient description.

HALMATURUS MINOR, OW.

Sthenurus minor, Owen, VII. 1877, p. 353.

Macropus minor, Lydekker, IV. p. 218.

But seven examples of this species have been found; one is a maxilla in the same stage of growth as the type showing p.³, mp.⁴, m.¹, m.², and p.⁴ exposed in its crypt. The premolars are similar to those figured by Owen. The other examples are an isolated p.⁴; a young maxilla with m.¹ m.² m.³ and the premolar ready to emerge; two adult rami with all the true molars and one young ramus with all the cheek-teeth, but with these unfit for description. (Pl. XVIII. figs. 1-2).

HALMATURUS sp.

Molars with rectilinear crests, sharp angles and feeble links.

Lower premolar elongate, apparently with an intero-posterior cusp. Molars without posterior grooves or distinct talon.

Dimensions.

Mandibular.—The length of the full series of true molars is 28·7; the premolar between 8·5 and 9·0 (estimated). The width of m.³ is 5·8. The anterior depth of the mandible is 17·0; the posterior the same; the thickness 11·6.

The length of the molar series being greater than the extreme length in *H. dorsalis* and all wallabies inferior to it in size, while its width is much less than the least in *H. agilis* and *ualabatus*, and the length of the premolar greatly exceeding that in *H. ruficollis* and *M. parryi*, and even those of *H. agilis* and *ualabatus*, it is clear that this mandible is not referable to any known species.

In the only example extant the premolar is imperfect in length, and both it and the molars have been so long in wear as to

destroy any diagnostic features which may have existed in earlier life. It is worse than idle to confer on such a fossil names which cannot with certainty be extended to others.

HALMATURUS sp.

A portion of a right mandibular ramus of an aged individual with the last three and major part of the first true molars. The estimated length of the molar series is 34.5; the last three teeth measure 27.1. The width of the series at m.³ is 7.1. The mid-depth of the mandible is 18.5; its thickness 10.9.

The width of the teeth falls within the range of that in *H. agilis*, *ualabatus* and *ruficollis*. The depth of the mandible would allow it to be referred either to *agilis* or *ruficollis*; its thickness to either of the large wallabies or to *M. parryi*. But the species is readily distinguished from *H. ualabatus*, to which, among modern kinds, it has the greatest resemblance by the greater length and width of the anterior talon, which forms a much larger portion of the whole than in the recent tooth. In consequence of this amplification of the talon the tooth is elongated; selecting a mandible of *H. ualabatus* of the same age as the fossil, and with teeth of the same width, we find that the length of the series of true molars in the fossil is a tenth greater than in the living species, the talons being on the average a millimetre longer.

Until the premolar is known the species may be left unnamed.

HALMATURUS sp.

Molars with rather straight crests, subrotund angles, and moderately strong links; without posterior groove or talon; smooth.

Dimensions.

Mandibular.—The last three cheek-teeth measure 25.1 in length. The width of m.³ is 5.9. Posterior depth 14.8; thickness 11.0.

So far as it goes the fossil corresponds in size with *H. dorsalis*, and it is without any distinct marks of differentiation from that species; but as it is equally without characters, apart from

dimensions, which demand its identification with *H. dorsalis*, and as dimensions alone are a good servant but a bad master it would be a very rash step to announce on the evidence of this imperfect mandible the geological antiquity of the common scrub wallaby.

HALMATURUS sp.

Molars with curved crests, rounded angles and strong links; smooth. Lower molars with an incipient posterior groove, but no talon.

Dimensions.

Mandibular.—The last two molars are 16·0 in length. The width of m.³ 5·4. Thickness 8·7.

These dimensions have no counterpart among known species.

Examples.

A portion of an adult left ramus with m.³, m.⁴—A portion of a young right maxilla with mp.⁴ (part), m.¹, m.² may be provisionally referred to the same species.

HALMATURUS sp.

The anterior portion of a young ramus with m.² and relics of m.¹, the molars with rectilinear crests, angular lobes and feeble links, and the length of m.² barely 6·0 is insufficient for determination.

MACRUPUS MAGISTER, n.s.

M. titan, Owen, *partim*—Owen, **XXII.** Vol. ii. p. 360; II. Pl. 82, figs. 17-18; Lydekker, **IV.** p. 225; Etheridge, **V.** 183.

The validity of a new name for the paramount species among the kangaroos of the Nototherian Period depends on the proof to be adduced that the fossils referred by Owen to his species, *M. titan*, are by no means identical with it. The name *M. titan* was given by its author to a species represented by a portion of a young mandible with a single perfect tooth, m.² (m.¹ of II. Pl. 82, figs. 17, 18). With such straitened means of recognising the species in other examples it might have been supposed necessary

for safe determination that these or some one of them should have the corresponding tooth at least in fair accordance with that of the type tooth as to shape and proportions. According to the "improved figure" of the type tooth (*l.c.*) its diameters are 14.5 and 11; in adult life its length would be still less in proportion to its breadth. But in the adult mandibles identified with it by their describer the diameters of this tooth are respectively 14 and 9.5, 15 and 9, 15.7 and 10, yielding as a mean ratio 14.9 and 9.5; whereas, to maintain the typical proportions of even the young tooth, the respective widths should be 10.6, 11.4 and 12.6, or in the mean 11.5. This difference in proportions is quite obvious to the eye, and so far exceeds the latitude in this respect taken by modern kangaroos as to be entirely prohibitory of the accepted identification. In no one of scores of specimens whose specific co-identity has been ascertained by tracing them through every phase of dentition, and whose identity with the supposed co-types of *M. titan* is beyond question, does the tooth show any tendency to exchange its normal elongate form for the comparatively square shape notable in *M. titan*. The mean ratio of length to breadth deduced from ten adult examples taken at random is 14.5 : 9, and if we take mandibles equal in age with the *M. titan* type the difference is of course still more evident; in the young m.² the diameters are 14.8 and 8.8. A further proof of non-identity is the absence of a vertical groove from the hinder surface of the tooth in *M. titan*. This groove is present in the mandibles considered co-specific by Owen, and is invariably so in locally preserved examples.

Finally, the form and extent of the anterior talon of *M. titan* are very different from those of *M. magister* at the same age; that of *M. titan* is a semioval with a short minor diameter; that of *M. magister* is much longer, has straight converging sides and a short straight anterior edge. On these grounds Owen's identification of his Queensland examples of *M. titan* with his Wellington Valley type must be disallowed. It was a judgment, be it observed, delivered *ex cathedra* without reason assigned.



Molars smooth, elongate, with curvilinear crests, thick lobes, rounded angles and strong, directly longitudinal links. Base of revolute inner edge of hinder surface of upper molars elevated, forming an adpressed fold on the corresponding part of the anterior teeth; a vertical groove on the hinder surface of the lower molars. Upper premolar bilobate, with a small interoposterior cusp; lower premolar bilobate, with a large interoposterior cusp nearly confluent with the hinder lobe.

Dimensions.

Mandibular.—Adults: The entire series of cheek-teeth is 56·6 and 60·8 in length (2); the premolar from 6·4 to 7·6 (3). The series of true molars from 51·8 to 59·3 (8); the last three from 40·0 to 50·5 (33); the last two from 28·1 to 36·5 (39); m.⁴ from 16·2 to 20·0 (26); the first three 35·7 and 38·5 (2); m.², m.³ from 26·1 to 28·5 (3); m.² from 13·7 to 16·7 (5); m.³ from 16·1 to 17·6 (8); m.¹ 15·4 (1). The width of m.³ is from 9·0 to 11·6 (91). The anterior depth of the mandible is from 29·6 to 44·0 (60); the posterior from 26·6 to 41 (75); the thickness from 15·6 to 24·0 (76). The external length varies from 127·0 to 142·0 (6); the internal from 80·0 to 98·0 (20); the diastema from 61·0 to 70·0 (5); the symphysis from 56·0 to 69·0 (5).

Adolescents: The first four cheek-teeth are 53·0 (1); the series of true molars 60·0 (1); the first three molars from 40·2 to 48·4 (7); the first two 27·3 (1); m.² is 15·6 (1); m.⁴ 16·2 and 19·0 (2); m.², m.³ from 27·5 to 34·0 (11); m.³ from 16·0 to 17·4 (8); m.³, m.⁴ from 29·0 to 35·0 (5); the premolar from 7·2 to 8·6 (3). The width of m.³ is from 9·1 to 11·3 (33).

Young: P.³, mp.⁴, m.¹ measure from 29·9 to 32·5 (7); mp.⁴, m.¹, m.² from 35·2 to 43·5 (7); mp.⁴, m.¹, m.², m.³ from 45·0 to 50·0 (4); mp.⁴, m.¹ from 22·1 to 29·1 (15); m.², m.³ from 28·0 to 31·5 (4); p.³, mp.⁴ from 18·9 to 19·6 (6); mp.⁴ from 10·5 to 11·0 (3); m.¹ from 10·5 to 13·2 (8); m.² from 13·6 to 14·4 (3); m.³ from 15·5 to 16·0 (3); the premolar p.³ from 7·1 to 9·0 (16).

Maxillary.—Adults: The full extent of the cheek-teeth is from 62·5 to 65·7 (4); of the true molars from 54·0 to 60·6 (12); of the

last three molars from 41.5 to 45.0 (3); of the last two from 31.2 to 34.1 (7); m.⁴ is 15.5 and 16.9 (2); the premolar from 9.0 to 10.5 (5); the first four cheek-teeth from 43.7 to 46.7 (2); the first three molars from 40.0 to 45.0 (3); m.², m.³ from 30.1 to 32.0 (6); m.³ from 15.6 to 17.6 (6); m.² 12.6 (bis.).

Young: P.³, mp.⁴, m.¹, m.², m.³ are 56.7 and 63.5 (2); p.³, mp.⁴, m.¹, m.² 45.2 and 45.4 (2); p.³, mp.⁴, m.¹ are 35.5 (1); p.³, mp.⁴ 20.4 (1); p.³ from 9.0 to 10.0 (6); mp.⁴, m.¹, m.² from 35.4 to 38.7 (3); mp.⁴, m.¹ 26.5 (1); m.¹, m.² 25.8 and 27.7 (2); m.³ from 14.2 to 16.4 (3).

The widths of the lower and upper teeth are as 13 to 14; in *M. giganteus* the ratio is 7:8; in *M. robustus* 19:20; in most other recent species the difference is much greater than in *M. giganteus*.

In mandibular dimensions *M. magister* has no special relation to either of the recent kangaroos. Though the length of its cheek-teeth is but little more than a fourth greater, the mean width of the series at m.³ is more than twice as great, while the thickness of the mandible and its depth are only about one-half greater than in *M. giganteus*, *robustus* and *rufus*. In range of depth it somewhat exceeds the greatest attained by a recent species, *H. dorsalis*, to wit.

Form.

Mandibular.—P.⁴ (Pl. XVIII. fig. 12) is short, with mesial diameters 7.0:3.5. Anterior lobe the shorter, longitudinally compressed, lancet-shaped; the posterior single, or with its anterior two-fifths forming a subdivision obscurely defined by a vertical groove on the outer side, and a notch in the crest. Crest curving without interruption on to the intero-posterior cusp, which is only separated from the lobe by a shallow vertical groove on the upper mesial part of the posterior surface, and forms with it anteriorly a concave intero-posterior face.

P.³ (Pl. XVIII. fig. 11) is short, with mesial diameters 8.9:4.5, similar to p.⁴ in structure, but larger in size. The anterior lobe is relatively larger; the intero-posterior cusp is higher than the

hinder lobe, compressed, acuminate and separated from the lobe by a deep notch both superiorly and posteriorly.

The vertical groove on the hinder surface of the molars is sometimes double; frequently its base is enclosed by an elevated rim which may bulge outward and convert the groove into a deep pocket.

Maxillary.—P.⁴ (Pl. XVIII. fig. 14) has a general resemblance to the lower premolar, but the anterior lobe is much shorter and lower than the posterior, the long compressed blade of which bears low down on its intero-posterior surface a small trihedral pointed cusp. On the intero-anterior base of the fore lobe is a tumid margin *a*, representing perhaps the last trace of an inner ledge. Mesial diameters $10\cdot5 \times 4\cdot7$.

P.³ (Pl. XVIII. fig. 13) is almost equally bilobed; the maiden state of its surface is not exemplified, but from vestiges left in the worn tooth it may be safely said to have had a ledge running the whole length of its inner side and terminating in an intero-posterior cusp; the hinder lobe is furnished with a well developed extero-posterior cusp (*a*, Pl. XVIII. fig. 15), a feature which occurs in the recent *M. giganteus*, but in one other instance only among extinct Macropods in *Sthenurus*.

Examples—two hundred and eighty-three.

The collection embraces 134 adults, 40 adolescents, and 47 young mandibles—47 adult and 15 young maxillæ, besides isolated teeth in large number. The identity of young specimens has in the great majority of instances been established by extraction of the permanent premolars from their crypts.

It may be observed that Owen's *M. titan*, from the Wellington Caves, has not been recognised among the fossils of the Darling Downs.

MACROPUS PAN, n.s.

Molars elongate with curved crests, rounded angles and strong links. Anterior upper molars with the outer midvalley divided by a vertical plate; all with an adpressed fold posteriorly. Lower

molars with a vertical groove posteriorly. Upper premolars unilobate with an internal ledge and intero-posterior cusp. Lower premolar unilobate, with an intero-posterior cusp. Size somewhat larger than *M. magister*.

The types of the species are the maxillaries alone; there is at present no direct evidence showing that the mandibles are rightly associated with them.

Dimensions.

Maxillary.—Adult and adolescent: The first four cheek-teeth are in length 55.0 and 55.5 (2). The true molar series is 53.6 and 61.5 (2); the last three molars 44.5 to 55.0 (4); the last two 36.0 (1); the last 19.2 (1); the first three 41.3 (1); m.², m.³ from 30.1 to 37.1 (5); p.⁴ is from 11.0 to 12.3 (3). The width of m.³ is from 11.7 to 13.6 (14).

Young: The series mp.⁴, m.¹, m.² is 40.0 (1).

Mandibular.—Adult and adolescent: The cheek series varies in length from 61.0 to 70.0 (2); the last three from 42.7 to 54.0 (4). The first four cheek-teeth are 52.2 in length, the first two true molars from 26.8 to 29.6 (3); the last two from 35.5 to 39.5; the first three are 45.6 (1); m.² m.³ are 35.2 (1); m.¹ 12.0 and 12.5 (2); m.² from 16.9 to 17.4 (3); m.³ from 17.5 to 20.0 (8); m.⁴ from 18.7 to 20.5; p.⁴ from 8.0 to 10.0 (4). The width of m.³ is from 8.9 to 12.6 (24). The anterior depth of the mandible varies from 24.6 to 46.2 (13); the posterior from 23.5 to 36.6; its thickness from 15.8 to 25.1 (27). The latter measurements much exceed the greatest amount of difference in living species, and clearly indicate a confusion of two distinct species, but the means of distinguishing these otherwise than by size are as yet wanting.

Form.

Maxillary.—P.⁴ (Pl. XVIII. fig. 8). Obovate with diameters 11.0 and 6.6. Crest oblique, parallel with the outer side, notched at anterior third. An intero-posterior cusp *a*, separated from the lobe apically by a notch, posteriorly by a broad groove descending half way to the base, is connected with the fore end of the crown

by a raised tubercular basal rim enclosing a concave ledge. Outer surface of crown impressed at anterior third, the impression defining the outer edge of an anterior cusp *b*; on the posterior half of the impression are two very distinct vertical ribs. In a maxilla which seems to belong to this species the premolar (Pl. XVIII. fig. 8) is elongate obovate, with diameters 12·3 and 5·7 and a little contracted at the anterior third. The intero-posterior tubercle is more entirely separated from the lobe; and the whole tooth has a facies different from that of the preceding tooth, which may be taken as the type of the species. Yet as *m*.¹ in this maxilla has relics of the sepiment in its outer midvalley, and as the variation in the premolar may be paralleled among recent species, there is not at present sufficient ground for referring it to a separate species.

Molars (Pl. XVIII. fig. 10).—The posterior molars differ in no respect from those of *M. magister* save in somewhat superior size; *m*.² most frequently shows a vertical fold descending from the middle of the hinder surface of the fore lobe external to the mid-link, and meeting its fellow of the opposite side at the bottom of the valley *b*; or as in the type specimen forming there an erect plate. In *m*.¹ this fold forms a more complete sepiment *a* from lobe to lobe; it is constant in occurrence, and traces of it are visible as long as the lobes persist. It is not a little remarkable that this one of the structural characters of *Palorchestes* should reappear in a species of *Macropus*.

Mandibular.—*P*.⁺ (Pl. XVIII. fig. 7) ovate, with the sides mesially contracted, and with diameters 8·0 and 4·0. Crest mesial; a very small intero-posterior cusp separated from the lobe apically and posteriorly; inner side of crown somewhat concave in front of the cusp, outer rather concave with one or two obscure ribs about the middle. The cusp disappears under wear. A series of four young teeth extracted from their crypts at an early stage of growth or exposed from above shows that the tooth in its growth undergoes considerable change of form. At the earliest phase observed it resembles in shape the end of a cold chisel with a dent on each

side of the middle of its edge, the mid-point being the termination of a rib on the outer side; the intero-posterior cusp is as yet obscurely defined; in a somewhat older example the crown is thickened and rounded at each end, two ribs appear on the outer side, and the intero-posterior cusp is more distinct; when near emergence the tooth gains greater robustness, and the cusp becomes exerted from the lobe.

Molars (Pl. XVIII. fig. 9) undistinguishable from those of *M. magister*.

The undulation of the lower contour line of the mandible is well marked.

Rise and fall of teeth.

Of this little is known; $\underline{p.}^4$ is newly arisen, and $\overline{p.}^4$ is not entirely up when the hind lobe of $\underline{m.}^3$ is coming into use; by the time that the hind lobe of $\underline{m.}^4$ gets into wear, $\underline{p.}^4$ is moderately worn and procumbent, whence we may infer that it is thrust out soon afterwards while still serviceable.

Examples—fifty-four.

These include besides the young maxilla forming the type — Four adult maxillæ; two with premolars, and all with $\underline{m.}^1$ among the teeth preserved; twelve others in which $\underline{m.}^2$ shows its characteristic more or less perfectly; one with $\underline{m.}^3$, $\underline{m.}^4$; one with $\underline{m.}^3$; and one with $\underline{m.}^4$ referred to the species merely on account of similarity of size.

In four adolescent mandibles the well-preserved premolars alone effectually prevent the molars behind them being ascribed to *M. magister*, as they might otherwise have been on seemingly sufficient grounds, and well illustrate the folly of positively identifying kangaroo mandibles by molars only. Twenty-seven others are provisionally determined by the dimensions of the teeth.

MACROPUS FAUNUS, n.s.

Molars with curved crests, rounded angles and strong links.

Upper premolar tricuspid, without ledge on the inner side, but with an intero-posterior member simulating the corresponding

portion of the true molars. Molars smooth. Lower premolar tricuspid. Palate entire. Size large.

Dimensions.

Maxillary.—Length of the cheek-teeth 70·5 (estimated), of the first four 55·5 (1); of p.⁴ 11·0 (1). Width of m.³ 12·5 and 12·8 (2).

Mandibular.—Length of the cheek-teeth 57·0 to 62·6 (2); of p.⁴ 7·0, 7·2 and 8·0 (3); of p.⁴, m.¹ 18·0 (1). Width of m.³ 9·5 to 10·1 (2); anterior depth 25·8 and 29·0 (3); posterior 28·0 and 29·0 (2). Thickness 19·7 and 21·0 (2). Internal length 82·0.

Form.

Maxillary.—P.⁴ (Pl. XVIII. fig. 4) irregularly elongate-ovate, tricuspid; the mesial cusp the shortest, cuneiform; the anterior a compressed cone. The large inner portion of the posterior cusp is fused with the outer; its posterior base folds backwards and outwards behind the base of the outer portion so that the posterior surface of the tooth has a remarkable resemblance to that of the molars of the kangaroos. The inner ledge is represented by a low basal tubercle opposite the interval between the anterior and mesial cusp. Diameters 11·0 and 4·6.

Molars (Pl. XVIII. fig. 5) not distinguishable in form from those of *M. magister* and *pan.*

Mandibular.—P.⁴ (Pl. XVIII. fig. 3). Diameters 8·0 and 3·4. Tricuspid, elongate-ovate. Crest parallel with outer side, curving inwards posteriorly; mesial cusp the shortest, cuneiform. Crown tumid on intero-posterior angle but not developing a distinct cusp.

Molars (Pl. XVIII. fig. 6) as in *M. magister* and *pan.*

Lower contour line of mandible undulatory.

Rise and fall of teeth.

The mandibular premolar is procumbent on the verge of the diastema when the hind lobe of m.⁴ is just showing effects of wear.

Examples—six.

The type maxilla with p.⁴, m.¹, m.², m.³—A portion of a left maxilla with m.³, m.⁴ (provisional)—A mandible with all the cheek-teeth and a portion of a second with p.⁴, m.¹—A pair of mandibles, one with all the cheek-teeth, the other lacking only the premolar.

The close similarity in form between the upper and lower premolars strongly suggests their co-specific origin. The molars accompanying them could not without them be dissociated from those of the other great kangaroos.

SYNAPTODON, de Vis.

Synaptodon, de Vis, Proc. Roy. Soc. Queensland, Vol. v., p. 159.

Molars distant at base, in contact by faceted projections (talons) fore and aft.

SYNAPTODON ÆVORUM, de Vis (*l.c.*).

Dimensions of a molar 9.0 × 5.0; space between the teeth nearly equal to the length of the fore lobe.

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EXPLANATION OF PLATES.

Plate XIV.

Palorchestes azael, Ow.

- Fig. 1—Lower deciduous premolar.
- Fig. 2—First lower true molar—young.
- Fig. 3—Anterior upper molars—young.
- Fig. 4—Lower permanent premolar.
- Fig. 5—Upper permanent premolar.
- Fig. 6—Last upper molar.

Palorchestes parvus.

- Fig. 7—First upper molar—young.
- Fig. 8—Upper molar series.
- Fig. 9—Lower molar series.
- Fig. 10—Upper incisors.

Plate xv.

Sthenurus pales.

- Fig. 1—First three lower molars.
- Fig. 2—Upper premolar.
- Fig. 3—Lower premolar.
- Fig. 4—Hinder surface of third lower molar.

Sthenurus goliath, Ow.

- Fig. 5—Upper deciduous premolar—imperfect.
- Fig. 6—Upper permanent premolar in crypt.
- Fig. 7—Lower permanent premolar.
- Fig. 8—Hinder surface of first upper molar.
- Fig. 9—Hinder surface of last upper molar.

Plate xvi.

Sthenurus otuel, Ow.

- Fig. 1—Lower permanent premolar.
- Fig. 2—Lower third molar.
- Fig. 3—Upper permanent premolar.
- Fig. 4—Upper third molar.

Sthenurus oreas.

- Fig. 5—Lower permanent premolar.
- Fig. 6—Lower third molar.
- Fig. 7—Upper permanent premolar.
- Fig. 8—Upper third molar.

Sthenurus atlas.

- Fig. 9—Lower deciduous premolar—imperfect.
- Fig. 10—Lower permanent premolar.
- Fig. 11—Last lower molar—imperfect.

Halmaturus vinceus.

- Fig. 12—Upper permanent premolar.
- Fig. 13—Lower permanent premolar.
- Fig. 14—Upper third molar.
- Fig. 15—Lower third molar.

Plate xvii.

Halmaturus thor.

- Fig. 1—Lower permanent premolar.
- Fig. 2—Lower third molar.

Halmaturus vishnu.

Fig. 3—Lower permanent premolar.

Fig. 4—Lower third molar.

Halmaturus anak, Ow.

Fig. 5—Lower deciduous premolar.

Fig. 6—Lower permanent premolar.

Fig. 7—Upper deciduous premolar.

Fig. 8—Upper permanent premolar.

Fig. 9—Lower third molar.

Fig. 10—Upper third molar.

Halmaturus dryas.

Fig. 11—Lower deciduous premolar.

Fig. 12—Lower permanent premolar.

Fig. 13—Upper permanent premolar.

Fig. 14—Lower third molar.

Fig. 15—Upper third molar.

Halmaturus odin.

Fig. 16—Lower permanent premolar.

Fig. 17—Lower third molar.

Halmaturus indra.

Fig. 18—Lower deciduous premolar.

Fig. 19—Lower permanent premolar.

Fig. 20—Lower first molar.

Halmaturus siva.

Fig. 21—Lower permanent premolar.

Fig. 22—Lower third molar.

Fig. 23—Upper third molar.

Halmaturus cooperi, Ow.

Fig. 24—Lower deciduous premolar.

Fig. 25—Lower permanent premolar.

Fig. 26—Lower third molar.

Fig. 27—Upper third molar.

Fig. 28—Upper permanent premolar.

Plate XVIII.

Halmaturus minor, Ow.

Fig. 1—Lower permanent premolar.

Fig. 2—Lower third molar.

Macropus faunus.

Fig. 3—Lower permanent premolar.

Fig. 4—Upper permanent premolar.

Fig. 5—Upper third molar.

Fig. 6—Lower third molar.

Macropus pan.

Fig. 7—Lower permanent premolar.

Fig. 8—Upper permanent premolar.

Fig. 9—Lower third molar.

Fig. 10—Upper third molar.

Macropus magister.

Fig. 11—Lower deciduous premolar.

Fig. 12—Lower permanent premolar.

Fig. 13—Upper deciduous premolar.

Fig. 14—Upper permanent premolar.

Fig. 15—Lower third molar.

Fig. 16—Upper third molar.

CORRIGENDA.

Page 78, in the last two lines—read *O. frenata* and *P. penicillata*.

Page 84, line 27—insert m.¹ between mp.⁴ and m.²

Page 85, line 15—add ; of the entire series of cheek teeth 98·5 (1).

Page 87, line 26—for premolars read the left premolar.

Page 88, line 4—for A second example, hinder portion, &c., read A second example—Hinder portion, &c.

Page 89, line 15—for orcas read oreas.

Page 93, line 4—after young add Cast of portion of a right maxilla with m.³ m.⁴ (10223); adult.

Page 94, line 5—the word but at the end of the line should have been omitted.

Page 99, lines 17, 29 and 31—for P.⁴ read in each case $\overline{P}^4$

Page 100, line 2—for P.⁴ read $\overline{P}^4$

Page 107, line 35—for lightly read slightly.

WEDNESDAY, MARCH 27TH, 1895.

ANNUAL GENERAL MEETING.

The twenty-first Annual General Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 27th, 1895.

The President, Professor David, B.A., F.G.S., in the Chair.

Miss Anderson, Mr. J. G. Anderson, M.A., and Mr. R. L. Jack, F.G.S., of Queensland, were present as visitors.

The Minutes of the last Annual Meeting were read and confirmed.

PRESIDENT'S ADDRESS.

The twentieth year of the Society's history, notwithstanding the still prevalent depression and continued "hard times," was one of almost unwonted activity. Sixty papers requiring a more liberal allowance of illustrations than usual were contributed at the nine Monthly Meetings of the Session. Five Parts of the Proceedings, including a legacy of arrears of three Parts from the previous year, were issued, while Parts 3 and 4 of the Vol. for 1894 have been issued since the commencement of 1895. These complete a Volume of average size, with more than the average number of plates; but they do not include three lengthy and important papers requiring illustrations, read at the November Meeting. To prevent delay and to distribute expenditure, these have accordingly been held over, and will without avoidable loss of time be issued as Part 1 of the Proceedings for 1895. Ever since the Macleay Memorial Volume was put in hand, four years ago, the Society has been uninterruptedly in the printer's hands,

a state of things which—with the matter held over from 1894 still for some time likely to occupy attention—even under favourable circumstances must continue for another year before we can hope to become quite free from the toils of arrears. The issue of five Parts instead of the usual four per annum means of course extra payments, and introduces a disturbing element into both the publishing arrangements and the finances for the year. Under these circumstances, therefore, it has become highly desirable that by the beginning of next year existing arrears should be cleared off in order that the Society may again revert to its normal condition; even though if necessary this should involve an unusual discrimination in accepting matter for publication during the coming Session.

By the operation of Rule ix. the Members' Roll has been depleted to the extent of forty-five names of Members whose annual subscriptions have continued in arrears. Some at least of these, it may be hoped, will take advantage of the last clause of Rule ix., and by the discharge of arrears again qualify themselves for Membership.

During the year five new Members were elected, two forwarded their resignations, and we have to lament the death of one—Dr. Craig Dixon—who was a prominent member of the Medical Profession in Sydney, and like his brother Dr. Thomas Dixon, to whose services on our Council we are all much indebted, was always a consistent supporter of our Society. For the reasons given above, and more particularly through the continued widespread commercial depression—though for this the Council is desirous of making all possible allowance—the number of effective Members on the Roll is at present smaller than it has been for some years—a fact which I commend to the consideration of the Members generally, in the hope that such a state of affairs may be only of a temporary character.

In the hope of encouraging a larger attendance of Members at the Monthly Meetings the Council early in the year decided as an experiment to hold the Meetings from June to November in town, at the University Chambers, kindly placed at our disposal by

Professor Pitt-Cobbett. The results either in the way of increased attendance or accessions to Membership were not of a striking character; and as an accompaniment of music practice in a contiguous building, and the absence of our books of reference were not found to enhance the interest of the Meetings, the Council has decided to return to our home at Elizabeth Bay. The inauguration of a new line of 'buses from the Railway Station to the top of William-street, via Oxford-street, providing for the convenience of residents in the western suburbs, and of the cable-tram to Ocean-street will be found to offer new and hitherto unattainable facilities of access to the Society's Hall.

Three vacancies on the Council occurred during the year through the successive retirement, on account of pressure of official duties, of Dr. Cobb, Mr. E. G. W. Palmer, and Mr. R. Etheridge, junr. In accordance with the provisions of the Act of Incorporation, the Council filled two of these vacancies for the unexpired portions for the then current year by electing Mr. A. H. S. Lucas, M.A., B.Sc., and Dr. Fick—who was, however, on the eve of leaving for Europe, and therefore unable to act—and whose place was thereupon filled by the appointment of Dr. C. J. Martin: the third vacancy occurring later in the year was left unfilled until the Annual Meeting. Mr. Henn, one of the Auditors, being absent on a visit to India, Mr. E. G. W. Palmer has been elected in his place.

As there arise from time to time questions of priority in the matter of species described in the first seven Volumes of our Proceedings which were issued undated, it is desirable that the effort should be made to ascertain the exact dates with a view to their publication in the Proceedings. Unfortunately the Society's official records for the period covered by Vols. i.-vi., and Parts 1 and 2 of Vol. vii., were entirely destroyed in the Garden Palace Fire. The Secretary, however, hopes by the co-operation of the Librarians of the various Sydney Libraries to be able to ascertain at least the dates on which the publications were received at those Institutions—which would be approximately those of publication. Old Members who are in a position to afford information are also cordially invited to do so.

With regard to the bequest of the late Sir William Macleay of £12,000 for the founding of a Chair or Lectureship in Bacteriology at the University of Sydney, or (failing the acceptance of the bequest by the University) for providing the salary of a bacteriologist to the Linnean Society of New South Wales and equipping a laboratory, the Senate accepted the bequest upon the terms and conditions mentioned in the will and memorandum. The Senate, however, of the University considering the fourth clause of the will rather stringent approached the Council of the Linnean Society with a view to obtaining a *cy pres* modification of this fourth clause. The fourth section of the memorandum provided that—"It shall be necessary for every student before being admitted to a Science or Medical degree at the University to attend a six months' course of bacteriology." The reply of the Council of the Linnean Society to the letter of the Senate was to the general effect that it declined to be a party to any scheme for modifying the late Sir William Macleay's will. The Senate then carried the matter into the Court of Equity, making the Linnean Society defendants.

As only a *résumé* has appeared in the newspapers, and the matter is one in which the Society is interested, I think it right that the full text of the decision of Mr. Justice Owen, Chief Judge in Equity, should be placed on record in the Society's Proceedings. It is as follows :—

Judgment of His Honour the Chief Judge in Equity.

IN THE SUPREME COURT OF NEW SOUTH WALES.

IN EQUITY.

Between The University of Sydney,
Plaintiff, and Her Majesty's
Attorney General for New South
Wales and the Linnean Society of
New South Wales, Defendants.

"This is a suit to obtain the declaration of the Court as to the construction of the will of the late Sir William Macleay.

The testator bequeathed a sum of £12,000 to the Senate of the University of Sydney in these terms:— “To be held upon trust for the foundation of a chair or lectureship of bacteriology subject to the conditions set out in a memorandum on the subject which I intend to leave with my will to be read as part thereof, but if the said Senate shall not, within one month after being notified by my executors of this legacy, accept the conditions set forth in such memorandum, then the said legacy shall be void, and I give the said sum of £12,000 to the Linnean Society of New South Wales.”

The memorandum referred to in the will is in these words:—

“To my Executors,

“This is the memorandum as to the legacy of twelve thousand pounds for a chair or lectureship of bacteriology referred to in my will of even date—I desire that the following conditions be strictly insisted on before handing over to the University the sum of twelve thousand pounds bequeathed in my will for the endowment of a chair of bacteriology :

“First the Senate must agree to accept the said sum for the purpose of providing from the interest of the same a salary for a lecturer or professor of bacteriology and whose duty shall be to give instructions practical and theoretical in the morphology and physiology of the Schizomycetes and Saccharomycetes :

“Secondly the bequest if accepted by the Senate shall be used for the abovementioned purpose and no other and the lecturer shall not have additional duties imposed upon him :

“Third the appointment of a professor or lecturer of bacteriology shall be made by the Senate and not delegated to people in England or elsewhere who know little of the country and care less.

“Fourth it shall be necessary for every student before being admitted to a science or medical degree at the University to attend a six months' course of bacteriology.

“My reasons for insisting upon these conditions being observed are that I am very deeply convinced of the extreme importance

of the study of these minute vegetable organisms both to the biologist and the physician but I am by no means sure that the importance is as yet sufficiently recognised by scientific men and I am unwilling to trust the fate of my bequest to the very uncertain views of the Senate on the subject. I therefore wish my executors to procure very distinct pledges from the Senate upon all the points above mentioned. Should the Senate decline all or any of these conditions I empower my executors to hand over the aforesaid sum of twelve thousand pounds to the Linnean Society to provide a sufficient salary by the year to a competent bacteriologist who shall be called the bacteriologist to the Linnean Society and whose duties shall be to conduct original research in the laboratory of the Society and to give instruction to one or two people at the discretion and under the orders and control of the Council of the Society any surplus to be applied to laboratory requirements."

The plaintiff prays for a declaration—

1st. Whether or not the words "science degree" in the fourth condition mean a degree in science generally or in biological science or other sciences analogous thereto; and

2ndly. Whether or not the words "a six months' course of bacteriology" in the fourth condition mean any and if so what definite amount of lectures or teaching or whether the words mean such amount of lectures or teaching as shall from time to time be prescribed by the Senate.

The will and memorandum bear date the 23rd December, 1890.

In the argument before me it was admitted that the "science degree" must be limited to a degree in biological science or other sciences analogous thereto, as the study of bacteriology would have no place in the curriculum for other science degrees, such as engineering, &c., and as the testator in the memorandum refers to the importance of such study to the biologist and the physician, I have therefore no difficulty in declaring that the "science degree" must be construed with such limitation.

The question as to the meaning of the words "a six months' course of bacteriology" presents greater difficulties. If those

words are to be construed according to their ordinary or grammatical meaning, they mean only that the studies are to extend over a period *of six months and two academical terms*, but it is contended that they have a technical meaning and imply a course of 100 lectures.

If that construction is to be put on the words, the Senate points out that such a course of lectures would in the present state of the science of bacteriology be only a waste of time to students both in medicine and science, and that the lectures for the most part would be mere repetitions of the few topics with which such lectures could deal.

The question, therefore, whether the Senate could properly comply with the condition or ought to reject the legacy depends on the construction of these words.

From the year 1875 up to the time of his death Sir William Macleay was a member of the Senate, and doubtless acquainted with its by-laws. Between the years 1875 and 1882 (before the School of Medicine in this University was fully organised), the by-laws in connection with the Faculty of Medicine required the candidate for the degree of Bachelor of Medicine to furnish evidence (amongst other things) that he had attended certain specified classes, "each for a course of six months." Between the years 1882 and 1884 the by-laws provided that the undergraduates in medicine should attend a six months' course of dissections, but I cannot find that the amount of instruction in such six months' course is anywhere laid down or defined. So far as I can ascertain, the expression "six months' course" nowhere else occurs in the by-laws of the University and is never used in connection with one course of study in science. From the year 1884, the expression appears to have dropped out of the by-laws, and from that year to the present the fourth by-law relating to the Faculty of Medicine provides for a "long course" and a "short course," to denote respectively a course of 100 hours' instruction extending throughout two terms; and of 50 hours' extending throughout one term.

I cannot see, therefore, from the by-laws that any such technical meaning as is contended for has been affixed to the expression "a six months' course," so that I must construe the words of the testator in that meaning. Indeed, if I am to suppose that the testator had in his mind the provisions of these by-laws when he drew up this memorandum, and intended students to attend a course of 100 lectures, I would have expected him to use the words "long course," which alone are defined as meaning a course of 100 hours' instruction extending throughout two terms.

Then it is said that at Edinburgh the expression "six months' course" is used to denote a course of instruction in medicine similar to the "long course" of the by-laws of the Sydney University; and that as the testator had in his youth been a student of medicine in that University, he used those words in the remembered sense of his early days. But I think I am right in stating that Sir William Macleay never took his degree in medicine, and that from early youth till his death at a very advanced age he resided in this colony, where he was for the last 15 years of his life an active member of the Senate of the Sydney University.

It appears to me, therefore, that a circumstance so far distant from the time when this will was executed ought not to compel the Court to hold that the testator used these words in the sense they bore in the University of Edinburgh.

Again, the evidence before me does, in my opinion, bear out the contention of the Senate, that in the present state of the science of bacteriology a course of 100 lectures on that subject could not benefit students, but would be a mere waste of time which could otherwise be more profitably employed – but as that science advances, a more extended course could from time to time be prescribed. If that is so, it must have been well known to the testator, and it is most improbable that he would have tried to force the Senate to give at the present time and under all circumstances such an extended course of lectures as would be useless to the students.

It is contended that the memorandum shows that the testator attached much greater importance to the study of bacteriology than the Senate did, and that that consideration shows that he must have intended to secure a maximum number of lectures on that subject.

I do not think that necessarily follows. The passage in the memorandum refers to all the conditions which certainly bind the Senate to give great prominence to the study of bacteriology in the degrees of medicine and science, but it does not at all follow that the testator meant himself to prescribe for all time the actual number of lectures to be delivered on the subject, especially when the evidence before us shows that so great a number of lectures as is contended for would at present be useless.

I gather from the by-laws that the Senate, on a report from the different faculties, determines from time to time the number of lectures to be delivered on each subject during the terms. And from the evidence of Professor Liversidge the number of lectures varies considerably. That course of procedure I must presume the testator, as a member of the Senate, was aware of.

It appears to me that in prescribing a six months' course of bacteriology, the testator did not mean to take from the Senate the power from time to time to prescribe the number of lectures to be given on the subject, but only to provide that each student for the degree of medicine or science should devote two terms to that particular study under a competent professor or lecturer.

I therefore declare that the words "a six months' course of bacteriology" mean such an amount of lectures or teaching throughout two terms as shall from time to time be prescribed by the Senate, having regard to the great importance which the testator attached to that study.

I think those last words ought to be added to the declaration of the Court, not through any fear that the Senate would in any way seek to evade the conditions, but as more fully expressing the intention of the testator.

The costs of all parties will be paid out of the legacy as between solicitor and client."

The Council of the Linnean Society decided, after due consideration, not to appeal against this decision. Mr. H. M. Makinson and Mr. J. J. Fletcher, as executors of Sir William Macleay, subsequently stated in a letter to the *Daily Telegraph*, of November 14th, 1894, that had they been parties to the suit they would certainly have appealed. In arriving at the decision not to appeal, the Linnean Council were actuated, partly by the desire for peace and quietness, but chiefly by the consciousness of lack of funds to enable them to carry on a protracted legal contest, which might in the end have involved the Society in heavy expenditure.

Subsequent to this decision by the Court of Equity, the Senate appointed a committee consisting of the Chancellor, the Vice-Chancellor, Dr. MacLaurin, Sir Arthur Renwick, Dr. Sydney Jones, Professor Liversidge, Mr. H. C. Russell, and Professor T. P. Anderson Stuart to advise them further on the subject. As recommended by this committee, the Senate sent circular letters to the principal European and American Universities, asking for as full information as possible on the subject of the teaching of Bacteriology. Replies to these circular letters are now being received. It is hoped that it will be possible to have an appointment made to the Chair of Bacteriology by the beginning of the Academic year in 1896.

AUSTRALIAN MUSEUM.

Dr. E. P. Ramsay, owing to continued ill health, was forced last year to resign his position as Curator, after over 20 years' service. Mr. R. Etheridge, junr., who had for a considerable time previous been discharging the duties of acting Curator, has been appointed his successor.

The lack of funds during 1894 very much retarded the general work of the Museum, the efforts of the staff being chiefly confined to the preservation, and in some cases the rearrangement, of the existing collections, with the view of making room for future additions in the already overcrowded cases. The Mammalia have been enriched by the addition of examples of the second Australian

species of Tree Kangaroo (*Dendrolagus benettianus*, De Vis). Numerous nest-groups showing birds, nests, and eggs, and often the young, with natural surroundings, have been added to the Bird collection. The Reptilia and Batrachia were to a great extent withdrawn from exhibition, consequent on substitution of specimens and rearrangement in more appropriate cases. In connection with the lizards, this work had to a considerable extent progressed. A series of coloured casts of snakes have also been introduced. The general collections of Insects, Mollusca, and other Invertebrates were entirely transferred from their former resting places to the upper gallery of the new hall, and are at present undergoing a complete revision. The two latter are now practically completed. A very valuable addition to the Ethnological Collection was made by the presentation by the N.S. Wales Commission World's Columbian Exposition of a fine set of weapons and implements of the Alligator River Tribes, Port Darwin, and numerous urns and vases from the burial mounds of Arkansas, U.S.A.

The addition of the year, however, was the presentation by the Government of the "Cook Relics." These relics of the great circumnavigator, Capt. James Cook, R.N., F.R.S., were chiefly purchased, on a statutory declaration, from the surviving relatives of Mrs. Elizabeth Cook, relict of Capt. Cook. The declared value of these specimens is £1100. The entire general collection of Minerals and Rocks has been transferred to the lower gallery of the new hall, rearranged and re-labelled, to the number of about 5000 specimens. From causes it is unnecessary to mention, little palæontological work has been accomplished. The staff remains on its retrenched basis.

GEOLOGICAL MUSEUM, DEPARTMENT OF MINES AND AGRICULTURE.

Mr. G. W. Card has been working hard at the displaying and arranging of the mineral and palæontological collections. Important additions, chiefly of silver ores and opals, have been made to the collection during the past year. The palæontological collections have been classified by Mr. R. Etheridge, junr., and Mr. W. S. Dun.

UNIVERSITY.

At the Biological Laboratory of the University, Mr. J. P. Hill is working at the development of the teeth of the bandicoot. At the laboratories of the Medical School Professor Wilson is studying the same subject in collaboration with Mr. Hill, and also the development of the teeth of the platypus. Dr. C. J. Martin is still continuing his investigations on the subject of snake poison, and is working out the general development of the platypus. At the Macleay Museum Mr. George Masters is still employed at his task of classifying the collections of foreign *Orthoptera* and *Coleoptera*, and has mounted on ground glass all the collections of Australian and foreign birds' eggs and a large number of marine and land mollusca.

SCIENTIFIC PAPERS, &c.

It would, of course, be quite beyond the scope of this address to review the principal papers of scientific interest which were published by Australian Societies last year. A few publications, however, relating to my own subject will be referred to. The very important paper by Mr. R. L. Jack, at the Brisbane meeting of the Australasian Association for the Advancement of Science, showed that his geological survey of the intake beds of the cretaceous formation proved that the supply of rain water draining into the beds was fully forty times as much as had been previously estimated. On the assumption, therefore, that a total of about one hundred million gallons flow now daily from the Queensland artesian bores, it should be possible to draw at least forty times as much as the above amount of water out of the beds without encroaching on the supply. The geological explorations by Mr. E. F. Pittman, the Government Geologist, during the past year, on the cretaceous rocks of the Upper Darling and in the Parish of Bidura, Balranald district, have shown that it is very probable that the artesian basin may extend far to the south-west of Wilcannia, possibly underneath the overlying Tertiary deposits of West Victoria and South-East South Australia to the coast.

During 1894 the Department of Mines and Agriculture have published Parts I. and II. of Vol. IV. of the Records of the Geological Survey of New South Wales and Part III. No. 8 of the Palæontology Series of the Memoirs. The last-mentioned is entitled "Contributions to a Catalogue of Works, Reports, and Papers on the Anthropology, Ethnology, and Geological History of the Australian and Tasmanian Aborigines," and should prove of great service to workers in that branch of science. A very interesting memoir by Mr. A. S. Woodward, of the British Museum, on the subject of the beautifully preserved fossil fish, discovered at the Talbragar River, has just been received by the Government Geologist, and will shortly be published. The reputation of the Survey is well sustained in these publications.

Mr. R. Etheridge, junr., and Mr. W. S. Dun, assistant palæontologist and librarian, contribute (*op. cit.* Part II. pp. 68-99) "The Australian Geological Record for the Year 1893, with Addenda for 1891 and 1892." This is an invaluable work, and no geological library in Australasia should be without it.

Mr. W. S. Dun, who has been assisting Mr. R. Etheridge in his palæontological work for several years, was this year appointed definitely to the position of assistant palæontologist to the Geological Survey.

MINING NOTES.

I am informed that the "Sydney Harbour Collieries Company" has been successfully floated in London, and that arrangements are being made to purchase Kurraba (Karubah) Point, between Neutral Bay and Shell Cove, and also for the sinking at this spot of a pair of shafts, which should reach the Bulli Coal Seam at approximately the same depth below sea level as that at which the seam was struck in the No. 2 bore at Cremorne, namely, 2774 feet, or probably a trifle deeper. The sinking of these shafts will afford good opportunities for obtaining a series of observations on underground temperature.

The output of gold for 1894 was 324,787 ozs., valued at £1,156,717, as I am informed by the Honourable the Minister for

Mines and Agriculture. This is nearly double the quantity raised in 1893, the amount for that year being 179,288 ozs., valued at £651,285.

Of the amount of gold raised last year the new goldfield of Wyalong contributed 9649 ozs., valued at £35,946, and Garangula 1205 ozs.

As representing the subject of geography as well as geology at the University of Sydney, I trust I may be allowed to say a little about recent research in the Arctic and Antarctic regions. The latter region in particular touches very nearly the work of our Society, and the problem of the possible biological relations of the Australian fauna to that of the old fauna of the Antarctic continent of New Zealand and South America has already engaged the attention of one of our most active members, Mr. Hedley.

ARCTIC EXPLORATION.

At least three expeditions last year were making for the North Pole. Nansen, the hero of the "First Crossing of Greenland," strong in will and limb, was, and we hope still is, drifting with his thirteen men in his wooden ship the *Fram* in the ice pack, from N.E. Siberia towards the strong ocean stream flowing south between Spitzbergen and Greenland, to which he trusts for carrying his ship over the North Pole. Nansen, when he bade good-bye to Dr. John Murray, who had expressed some doubt as to whether he should ever see again Nansen's ship, the *Fram*, said, "I think you are wrong. I believe you will welcome me on this very deck, and after my return from the Arctic, I will go to the South Pole, and then my life's work will be finished."

The American naval engineer, Lieutenant Peary, with a party of fourteen, including Mrs. Peary and her maid, started in July, 1893, for Whale Sound, on the west coast of Greenland. The chief object of the expedition was to complete the map of Greenland, but he also intended to reach the highest northern latitude available. He landed at Bowdoin Bay on March 6, 1894, and started overland with dogs and sledges for Independence Bay.

After pushing north for over 200 miles very severe weather compelled him to return. The temperature at times was 40° to 60° below zero. The sledges had to be abandoned, and only twenty-six dogs out of the ninety taken with him returned alive. Professor Chamberlin accompanied the expedition, and the publication of his observations on Greenland glaciers is being eagerly awaited by geologists in all parts of the world.

Mr. Walter Wellman, a journalist of Washington, attempted last year to attain a high northern latitude, north of Spitzbergen. He took with him aluminium boats, made at Baltimore, weighing about 450 lbs. each, 18 ft. long, 6 ft. wide and 2 ft. deep, capable of carrying nineteen men. The aluminium plates were riveted together Clinker fashion, being only one-tenth of an inch thick. Ash runners were fitted on to the bottom of the boat, so that it could be used as a sledge. Wellman's expedition failed in its attempt, so far as the attaining of a high northern latitude was concerned. Four days after he had left his ship (the *Ragnvald Jarl*) on his journey across the snow, she was crushed by ice, and only some of the stores were saved. Wellman and his party, after making some interesting geographical explorations, returned to Tromsø on August 15th, 1894.

An English expedition, known as the Jackson-Harmsworth expedition, was fitted out last year at the private expense of Mr. A. C. Harmsworth, for Arctic exploration. Mr. T. G. Jackson sailed from the Thames on July 11th, 1894, in the *Windward*, a wooden steamship of 321 tons. She is barque-rigged, and strongly fortified for ice-work. He has taken a whaling boat, a copper boat with collapsible canvas gunwales altogether weighing less than 200 lbs., a light boat of Norwegian pine and an aluminium boat built in three sections, with a duplicate of the middle section, and a birch bark canoe, together with sledges and twenty-four pairs of ski in lieu of snow-shoes. He takes a number of scientific instruments, travelling tents, sledges, four ponies and thirty dogs. It is hoped that scurvy, the bane of Arctic explorers, will be avoided by the frequent use of fresh meat, of which large supplies have been taken. A series of

depôts are to be established from Franz-Josef Land towards the North Pole, which should constitute well-stocked larders for the travellers as they return. Seven men, each of special skill or scientific attainments, accompany Mr. Jackson on this well found expedition.

The latest news of it which has reached me is to the effect that, towards the end of August, the *Windward* was seen by the captain of the walrus-sloop *Betsy* in latitude $75^{\circ} 45'$ N., and longitude 44° E., "steaming in the direction of Franz-Josef Land without let or hindrance, the ice being in this locality brashy and rotten, the *Windward* actually steaming up a lead of which no termination northward was visible."*

A somewhat novel proposal, which is likely to lead to the actual fitting out of an expedition to carry it into execution, comes from the famous Arctic explorer Julius V. Payer. He proposes to send an artistic expedition to paint the North Pole.†

The expression to "paint the town red" is a familiar one, but Payer does not propose to do anything so frivolous. No attempt has ever yet been made to do justice to the beauties of Arctic scenery, of which he gives a glowing account in the article just referred to. He proposes to take, on a 400 ton ship, two landscape painters, an animal painter, and a photographer. Movable glass studios lighted by electricity supplied by benzine or petroleum motors are to be provided, and oils which remain liquid at very low temperatures may be used instead of water colours. Cape Franklin, at the entrance of the little-explored Kaiser-Franz-Josef Fiord in East Greenland may be selected as the first camping ground. It is proposed that the expedition should start in June, 1896.

ANTARCTIC EXPLORATION.

Just now Dr. John Murray, of *Challenger* renown, has strongly stirred the hearts of the English people to fit out an expedition to the South Pole on somewhat similar lines to the great exploring

* The Geogr. Journ. Feb. 1895, Vol. v. No. 2, p. 173.

† The Geogr. Journ. Feb. 1895, Vol. v. No. 2, pp. 106-112.

expedition under Sir James Ross and Captain Crozier in the *Erebus* and *Terror* in 1839-1843.

Dr. Murray remarked in his address to the Royal Geographical Society last year that it was now nearly two thousand five hundred years since the Phœnicians sent out the expedition under the command of Necho into the Southern Hemisphere. They arrived at the Cape of Good Hope, about 600 B.C., and reported that when rounding the Cape, heading westwards, they had the sun on their right hand, a statement of which Herodotus says, "This for my part I do not believe; but others may." Since the time of this voyage of the Phœnician sailors in their frail craft, we have no reason to be proud of the rapidity of geographical exploration in the Southern Hemisphere.

Until the beginning of this year only three exploring parties had passed beyond the limit of 70° S. lat., Cook in 1773, Weddell in 1823, and Ross in 1841 and 1842. This year, however, the whaler *Antarctic*, which has just returned to Melbourne, has had the honour of being the first ship for the last 52 years to penetrate beyond the 70th parallel, reaching lat. 74° S., in long. 171° E.

As a result of his explorations, Cook, as quoted by Murray, was convinced that "the greater part of this Southern Continent must lie within the Polar circle, where the sea is so pestered with ice that the land is thereby inaccessible. The risque one runs in exploring a coast in these unknown and icy seas is so very great that I can be bold enough to say that no man will ever venture further south than I have done." To prophecy thus is also risky, as both Weddell and Ross did subsequently venture much further south, as already stated.

The explorations of Ross, the discoverer of the North Magnetic Pole, stand pre-eminent in the record of Antarctic work. In his case the path of duty was the way to glory. His orders were to try and discover the Magnetic Pole, and accordingly he steered as straight as he could towards where previous observations showed that the Magnetic Pole probably lay, and this proved to be also the best direction for successful geographical exploration. Sir Joseph Hooker, one of the only two members now surviving of

Ross' expedition, thus describes Ross' forcing a passage through the ice*—

“He steered for the position of the Magnetic Pole, and, after passing through much loose ice, met the main pack, about lat. 67° S. and long. $174\frac{1}{2}^{\circ}$ E. It was a formidable pack. Neither he nor any of the Arctic officers or men, of whom there were not a few in the ships, had ever seen anything like it in the north. Nevertheless, Ross determined to try it, and in doing so the boldest held his breath for a space. In four or five days he pushed through it and entered comparatively open water.” This proved to be a huge ocean pool 600 miles across, with a magnificent chain of extinct volcanoes, and one active volcano, bounding it on the east, the highest peak, Mount Melbourne, being estimated to be 15,000 feet high. The sun often shone brilliantly on those stupendous snow-clad peaks as Ross and his men fought their way gallantly southwards until they reached the great ice barrier rising in a sheer cliff 150 feet to 200 feet above the sea, and barring further progress to the South. On the East the ice pack, composed partly of floe ice (frozen sea water), partly of fragments of icebergs, hemmed them in, and they were compelled to return by the way they came. Speaking of the hardships endured by Ross and his men, during the third year of his commission, Hooker says (*op. cit.* p. 28), “It was the worst season of the three, one of constant gales, fogs and snowstorms. Officers and men slept with their ears open, listening for the look-out man's cry of ‘Berg ahead!’ followed by ‘All hands on deck!’ The officers of the *Terror* told me that their commander (Crozier) never slept a night in his cot throughout that season in the ice, and that he passed it either on deck or in a chair in his cabin. They were nights of grog and hot coffee, for the orders to splice the main brace were many and imperative, if the crew were to be kept up to the strain on their nerves and muscles.”

Ross' dredging showed that animal life was abundant right up to the edge of the great ice barrier; and the observations made during the Challenger Expedition quite confirmed this conclusion,

* The Geogr. Journ. Vol. iii. No. 1, January, 1894, p. 27.

for it was found that *tetrasporæ* were so abundant over wide areas as to give the sea a peculiar green colour, and "diatoms were frequently in such enormous abundance that the tow nets were filled to the brim with a yellow-brown slimy mass, with a distressing odour, through which various crustaceans, annelids and other animals wriggled."

One of the most recent Antarctic explorations was made in the *Jason* in 1893-1894. During the voyage of the *Jason* (Captain C. A. Larsen) to the Antarctic lands the discovery was made of a new active volcano, named by Captain Larsen Christensen Volcano, lat. $65^{\circ} 5' S.$, long. $58^{\circ} 40' W.$ *

"The volcano had the shape of a sugarloaf and was of considerable height. The ice was melted for a considerable distance around it. It presented a remarkable aspect, as round the top and on the slopes there were funnel-like holes, from which a very black and thick smoke issued from time to time, covering the top itself."

It is also stated (*op. cit.* p. 342) that to W. by N. from Christensen Volcano there are five islands, one of which is very high, and all probably volcanic, as their tops were free from snow, whereas those of the mountains on the mainland are snow-clad. On the sketch chart accompanying this paper the active volcano of Sarsee is shown in the same neighbourhood, and also Lindenberg Volcano [extinct (?)].

The *Jason* also visited Paulet Island, once an active volcano (*op. cit.* p. 344). It was quite clear of snow, its steep red cliffs thrown into relief by the grey background of the interior of the island, giving it a striking appearance. The most important discovery of the *Jason*, from a scientific point of view, was that of Lower Tertiary fossils *in situ*, at Cape Seymour. These were *Cucullæa*, *Natica*, *Cytherea* and pieces of petrified wood, all of course indicating a former climate much warmer than that which now prevails.

As regards climate, and distribution of animal and plant life, the Antarctic regions are in strong contrast with the Arctic.

* The Geogr. Journ. Vol. iv. No. 4, Oct. 1894, pp. 340-341.

In the Address to the Royal Geographical Society in July, 1894, by Clements R. Markham, C.B., F.R.S., it was stated (p. 9) that "from Payer's furthest point in $82^{\circ} 5' N.$, a water sky made its appearance in the north, the temperature rose, and the rocks were covered with thousands of auks and guillemots. From a height Payer looked down on a dark sheet of open water dotted with icebergs." On April 12 the thermometer was at 54° Fahr. In the discussion following the reading of Dr. Murray's address, Mr. W. S. Bruce, of the *Jason*, said (*op. cit.* p. 36) that as far north as man has penetrated in Arctic regions "he has found reindeer, flowers and bees, brilliant sunshine, and the country green; but in midsummer in the Antarctic no plant grows—the summer sun is not sufficient to melt the snow. The temperature observations on our voyage show that in the height of summer the average range of the thermometer is below 32° , and that in the latitude corresponding to the Shetland and Faroe Islands in the north."*

Dr. Murray also states that "No land animal, and no trace of vegetation—not even a lichen or a piece of seaweed—has been found on land within the Antarctic circle."†

Briefly summarised, what is known at present about the Antarctic Continent is this:—A. Its outline is probably something like that shown on the map exhibited, enlarged from Dr. Murray's map. That there really is a continent there and not merely a group of islands is proved by the following facts:—

- (1) The great ice barrier is a vast land glacier which must have a gathering ground of continental proportions, estimated by Dr. Murray as being slightly larger, perhaps, than that of Australia, namely, about 4,000,000 square miles.

* These observations, however, do not agree with those recently made by Mr. C. E. Borchgrevink of the whaler *Antarctic*. See Note 1, at end of this address.

† See Note 2, at end of this address.

- (2) Granite and various ancient crystalline rocks have been proved to occur *in situ* at the South Shetlands and Trinity Land, and granite and gneiss occur *in situ*, forming nine small islands off Terre Adélie, as observed by the French corvettes *L' Astrolabe* and *La Zélée*.^{*} Drift fragments of granite, dioritic rocks, quartzites, clay shales, &c., were dredged by the *Challenger* not far from the supposed Termination Land of Wilkes. Ross dredged a large piece of coarse granite off Victoria Land, and Dr. McCormick, the surgeon of the *Erebus*, frequently found fragments of granite in the crops of the penguins. His researches constantly proved that the penguins were invaluable as collectors of geological specimens. Granite is almost always characteristic of continents or of islands bordering continents, but is usually absent from oceanic islands.
- (3) Glauconite in the blue muds near the Antarctic barrier is probably indicative of the proximity of a continent.
- (4) Commenting on the fact that the observations during the *Challenger* expedition showed that 162 new species out of 398 identified are peculiar to Antarctic regions, Dr. Murray states (*op. cit.* p. 22), "It is most probable, indeed almost certain, that the floor of the ocean, as well as all pelagic waters, have been peopled from the shallow waters surrounding continental land, and here in the deep waters of the Antarctic we appear to have very clear indications of the existence of the descendants of animals that once inhabited the shallow water along the shores of Antarctica, while in the other regions of the ocean the descendants of the shallow water organisms of the northern continents prevail."

^{*} Voyage au Pôle Sud et dans l'Océanie. Sur les Corvettes *L' Astrolabe* et *La Zélée*, exécuté pendant les Années 1837-40. Géologie, Minéralogie, et Géographie physique du Voyage, Vols. xxii.-xxiii. Paris, 1848.

There are numerous volcanoes in the Antarctic Regions. Altogether there are about five active and seventeen dormant or extinct volcanoes, as far as I can learn from the somewhat imperfect information at my disposal. The volcanoes of Victoria Land show a tendency to linear arrangement. From Mount Sabine, 9,500 feet high, to Mt. Melbourne, 15,000 feet, the trend is sou-sou-westerly. Mount Erebus, 12,367, an active volcano, and Mount Terror, 10,884 feet, extinct, lie almost due South of Mount Sabine. Further north from Mount Sabine the great earth-fold, on the *septum* of which this chain of volcanoes is situated, probably bends a little westwards, as shown partly by the soundings, partly by the position of Balleny's Isle, an active or dormant volcano, estimated by Balleny to be about 12,000 feet high.* North-west of Balleny's Island the great fold trends perhaps to the knotting point between the Tasmanian axis of folding, described in my address last year, and that of New Zealand, the former perhaps running through Royal Company Island, and the latter through or near Auckland Island and Macquarie Island. The knotting point would probably be somewhere (approximately) near the intersection of the 60th parallel of south latitude with the 150th meridian of longitude east from Greenwich. It would thus join the line of extinct volcanoes along East Australia on the west; and perhaps the active volcanic zone of the North Island of New Zealand, or at all events the fold which bounds that continent, on the east.

Traced in the opposite direction, the volcanic zone probably runs through Seal Islands, the active volcanoes of Christensen and Sarsee, and through Mount Haddington, an extinct volcano in Trinity Land, to Paulet and Bridgman Islands, active volcanoes.

* Mr. C. E. Borchgrevink of the whaler *Antarctic* informs me that when he was in the vicinity of this island in 1895 he saw no trace of the volcano being in eruption. Sir James Ross, however, states (*Voyage to the Southern Seas*, Vol. i. p. 272), quoting from the log of the *Eliza Scott*, "as we stood in for it [Balleny's Isle, T.W.E.D.] we plainly perceived smoke arising from the mountain tops. It is evidently volcanic, as specimens of stone, or rather cinders, will prove."

The volcanic zone bends easterly from here on account of the easterly trend in the fold, which appears to make a loop towards South Georgia before it swings back towards Cape Horn. That there is a real easterly trend in the earth-fold at Trinity Land and the South Shetlands is proved by the observations made by the *Astrolabe* and *Zéleé* expedition, which record a strike in a N.N.E. and S.S.W. direction for the greyish-white limestones and phyllite-schists at the South Orkneys.* Towards Cape Horn from near South Georgia the fold probably trends west-nor-westerly, then follows an approximately meridional direction parallel with the chain of the Andes. It may be noted, however, that whereas the *Erebus* chain of Victoria Land is on the east side of the fold, the Christensen-Bridgman group are apparently on the opposite side. This may be due to the fact that at the latter locality the eastern slope of the fold is steeper than the western, as seems probable from the presence of the deep ocean abyss east of Graham's Land, as shown on Dr. Murray's map. The volcanoes of the Antarctic are thus situated on the same great earth-fold which has determined the position of the Cordillera and coast line of South America, and form part of that great "girdle of fire" which runs round about the earth, from the Andes along the west coast of North America and the Dominion of Canada through the Aleutian and Kurile Islands towards Japan, thence through various volcanic islands of the Pacific, including Krakatoa, towards the north-east extremity of New Guinea, to the Tonga Islands, and thence back to the White Island of New Zealand. It is probable, therefore, that the volcanic chain of Victoria Land will continue towards the South Pole, probably bending somewhat to the eastward, and will thence change its position to the fold on the other side of the Antarctic continent, so as to run through the Christensen-Bridgman line of volcanoes. In any case it is almost certain that high land, covered of course more or less by snow and glaciers, will be found at the South Pole. It may be mentioned here that the gneissic rocks in the small islands off Terre Adélie strike in an east and west direction.

This seems to prove the presence of a subsidiary fold trending easterly along the coast of Antarctica till it joins what may be termed the federated folds of New Zealand and Australia, near their knotting point. It will be important for future exploring expeditions to trace by a systematic series of soundings the position of these folds on the ocean floor, southerly from Tasmania and south by west from New Zealand.

That one, perhaps two,[†] well organised expeditions may shortly be expected in Antarctic regions is extremely probable, as may be judged from the following facts:—The Royal Geographical Society, after Dr. Murray's address in 1894, appointed an Antarctic committee. This committee moved the Council of the Royal Society to advocate strongly the need for further Antarctic exploration, and last December the Council of the British Association passed a resolution strongly in favour of the work being undertaken, and various scientific bodies, as well as the Agents-General of the Australasian colonies, have been approached on the subject. It is proposed to send a Belgian expedition into the Antarctic next September, the expedition to extend over eighteen or twenty months. It would be fully equipped for scientific observation, and the route suggested is one to the east of Graham's Land, in the direction of the recent discoveries of the *Jason*.

With reference to the lines on which Dr. Murray would suggest that an expedition to Antarctica should be conducted, he states (*op. cit.* p. 25):—"A dash at the South Pole is not, however, what I now advocate, nor do I believe that is what British science, at the present time, desires. It demands, rather, a steady, continuous, laborious and systematic exploration of the whole southern region with all the appliances of the modern investigator. This exploration should be undertaken by the Royal Navy. Two ships not exceeding one thousand tons should, it seems to me, be fitted out for a whole commission, so as to extend over three summers and two winters. Early in the first season a wintering

[†] Reference to a third proposed expedition is given in note 3, at the end of this paper.

party of about ten men should be landed somewhere to the South of Cape Horn, probably about Bismarck Strait at Graham's Land. The expedition should then proceed to Victoria Land, where a second similar party should winter, probably in Macmurdo Bay, near Mount Erebus. The ships should not become frozen in, nor attempt to winter in the far south, but should return towards the north, conducting observations of various kinds along the outer margins of the ice. After the needful rest and outfit at the Falklands or Australia, the position of the ice and the temperature of the ocean should be observed in the early spring, and later the wintering parties should be communicated with, and, if necessary, reinforced with men and supplies for another winter. During the second winter the deep-sea observations should be continued northwards, and in the third season the wintering parties should be picked up and the expedition return to England. The wintering parties might largely be composed of civilians, and one or two civilians might be attached to each ship; this plan worked admirably during the *Challenger* expedition."

"What, it may be asked, would be the advantages to trade and commerce of such an expedition? It must be confessed that no definite or very encouraging answer can be given. We know of no extensive fisheries in these regions. For a long time seal and sea-elephant fisheries have been carried on about the islands of the Southern Ocean, but we have no indication of large herds or rookeries within the Antarctic Circle. A whale fishery was at one time carried on in the neighbourhood of Kerguelen, but this right whale, if distinct from or identical with *Balaena australis*, appears to have become nearly, if not quite, extinct. Some expressions of Ross would lead one to suppose that a whale corresponding to the Greenland right whale inhabits the seas within the Antarctic ice, but we have no definite knowledge of the existence of such a species. Although "sulphur-bottoms" (*Balaenoptera musculus*), "finbacks" (*Balaenoptera Sibbaldii*), and "humpbacks" (*Megaptera boops*) are undoubtedly abundant, they do not repay capture. Ross and McCormick report the sperm whale within the Antarctic ice, but there is still some doubt on

this point. Though penguins exist in countless numbers they are at present of no commercial value. Deposits of guano are not likely to be of great extent. But it is impossible to speak with confidence on the commercial aspects of such an expedition—the unexpected may quite well happen in the way of discovery.”

With regard to the whales seen by Ross in the Antarctic ocean, Sir William H. Flower said (*op. cit.* p. 34): “The only right whale which has hitherto been found in the south is the black whale, which, if it exists in sufficient numbers, is profitable, and has yielded a great deal in former times, and was diffused pretty nearly all around the Southern Hemisphere, being once abundant off the Cape of Good Hope, Australia, and New Zealand, and I have no doubt is the species seen in Sir James Ross’ expedition further south.”

Dr. Murray thus sums up the work of a modern Antarctic expedition: “To determine the nature and extent of the Antarctic continent, to penetrate into the interior, to ascertain the depth and nature of the ice-cap, to observe the character of the underlying rocks and their fossils, to take magnetic and meteorological observations both at sea and on land, to observe the temperature of the ocean at all depths and seasons of the year, to take pendulum observations on land, to bore through the deposits on the floor of the ocean at certain points to ascertain the condition of the deeper layers, and to sound, trawl, dredge, and study the character of marine organisms.”

Professor Neumayer says: “It is certain that without an examination and a survey of the magnetic properties of the Antarctic regions, it is utterly hopeless to strive, with prospects of success, at the advancement of the theory of the earth’s magnetism.” It is certain also that without a knowledge of the geography and meteorology of the Antarctic regions no weather predictions for any part of the globe, much less for the Southern Hemisphere, can be considered absolutely reliable, however wisely they may have been forecasted.

All these expressions of opinion on the part of leaders of modern scientific thought as to the desirability of an expedition

being sent to the Antarctic regions to learn more about its meteorology, more about its biology, more about its physics, geography, and geology, the Linnean Society of New South Wales will, I feel confident, most heartily endorse. That the last great work of geographical, biological, and geological exploration in the world should be undertaken by the people of the British Empire is a consummation devoutly to be wished for; and it would be a very worthy end of the grand work begun and continued by the great *Challenger* expedition.

There is more than mere political glory and problematical guano to be gained by such an expedition as that which is now contemplated to Antarctica. There is the good of humanity and the cause of truth. Scientific Societies have been appealed to to help on this enterprise, and we all can help, if not with our money at all events with our minds. If the Linnean Society of New South Wales cannot contribute men or money, I hope most sincerely that it will at least contribute a very hearty sympathy.

NOTES.

1. Mr. C. E. Borchgrevink, who accompanied the whaler *Antarctic* on its voyage to Balleny's Island and Victoria Land, stated in his lecture delivered in Sydney on April 24th that the shade temperature was by day as high as 46° Fahr., and the mean temperature for January, 1895, was 32.5° Fahr.

2. Mr. C. E. Borchgrevink obtained land plants (which Mr. J. H. Maiden, F.L.S., F.C.S., informs me are probably lichens) from Possession Island, and from Cape Adair, on the mainland of Victoria Land.

3. While the proofs of the above Address were being revised the following announcement in the *Scientific American*, March 30th, 1895, p. 202, has been brought under my notice by Mr. H. C. Russell, the Government Astronomer:—"Dr. Frederick A. Cook, the well-known explorer, has recently declared his intention of leading a small but well-equipped body of scientific men on an exploring expedition to the Antarctic regions. The time for leaving New York has been fixed for September 1st, 1895, and it

is expected that the voyage will last for probably three years. The party intend to sail in two small sailing vessels, each of about 100 feet in length and of from 100 to 200 tons burden. Each vessel will be of the type known as 'Sealers,' and will be manned by five men. . . . A fine pack of Esquimaux sledge dogs will also be provided. The scientific corps will consist of five men, who will carry with them such equipments as will assist them in carrying out their various lines of investigation. It is expected that it will take about three months to reach the Gulf of Erebus and Terror, where the expedition will probably disembark. A substantial wooden house will then be erected to be used as the headquarters. Later on, sledging parties will be sent out from this point to penetrate as far south as possible."

On the motion of the Rev. J. Milne Curran, seconded by Mr. T. Steel, a very hearty vote of thanks was accorded to the President for his very interesting Address.

The Hon. Treasurer being detained by Parliamentary business, Mr. P. N. Trebeck presented and read on his behalf a satisfactory financial statement, and also the Auditors' report.

On the motion of Mr. Trebeck, seconded by Mr. R. Etheridge, junr., the statement and report were adopted.

The following gentlemen were elected

OFFICE-BEARERS AND COUNCIL FOR 1895.

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HENRY DEANE, M.A., M.I.C.E.

VICE-PRESIDENTS :

JAMES C. COX, M.D., F.L.S.

PROFESSOR W. A. HASWELL, M.A., D.Sc.

PROFESSOR T. W. E. DAVID, B.A., F.G.S.

HONORARY TREASURER :

THE HON. JAMES NORTON, LL.D., M.L.C.

COUNCIL :

JOHN BRAZIER, F.L.S.	J. H. MAIDEN, F.L.S., F.C.S.
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J. R. GARLAND, M.A.	P. N. TREBECK, J.P.
ARNOLD U. HENN, F.E.S.	THOMAS WHITELEGGE, F.R.M.S.
A. H. S. LUCAS, M.A., B.Sc.	PROFESSOR J. T. WILSON, M.B., CH.M.

AUDITORS :

HUGH DIXSON, J.P.	E. G. W. PALMER.
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Mr. Henry Deane having taken the Chair, returned thanks for his election. He announced that Part 4 of the Proceedings for 1894 would be issued on the following day; also that the Council had decided to hold over to form Part 1 of the Proceedings for 1895 three lengthy papers requiring illustrations, read at the Meeting in November; and as these were sufficient to keep both printer and lithographer occupied for the next two months at least, the Monthly Meeting had been given up on this occasion.

The Meeting then closed.

WEDNESDAY, APRIL 24TH, 1895.

The President, Mr. Henry Deane, M.A., M.I.C.E., in the Chair.

DONATIONS.

(Received since the Meeting in November, 1894.)

Pharmaceutical Journal of Australasia. Vol. vii. (1894), Nos. 11-12; Vol. viii. (1895), Nos. 1-3. *From the Editor.*

Perak Government Gazette. Vol. vii. (1894), Nos. 25-31 and Index; Vol. viii. (1895), Nos. 1-6. *From the Government Secretary.*

Zoologischer Anzeiger. xvii. Jahrg. (1894), Nos. 459-464 and Index; xviii. Jahrg. (1895), Nos. 465-470. *From the Editor.*

Royal Microscopical Society—Journal, 1894, Parts 5-6; 1895, Part 1. *From the Society.*

Madras Government Museum—Bulletin, No. 2—"Notes on Tours along the Malabar Coast (1894)." *From the Superintendent.*

Société d'Horticulture du Doubs, Besançon—Bulletin. n.s. Nos. 46-50 (Oct., 1894-Feb., 1895). *From the Society.*

Marine Biological Association of the United Kingdom—Journal. New Series. Vol. iii. Nos. 3-4 (1894). *From the Association.*

Smithsonian Institution—Proceedings of the U.S. National Museum. Vol. xvi. (1893). *From the Museum.*

Smithsonian Institution—Annual Report of the Board of Regents for the year ending June 30th, 1892. *From the Institution.*

American Naturalist. Vol. xxviii. (1894), Nos. 335-336; Vol. xxix. (1895), Nos. 337-339. *From the Editors.*

American Geographical Society—Bulletin. Vol. xxvi. No. 3; No. 4, Part 1 (1894). *From the Society.*

American Museum of Natural History—Bulletin. Vol. vi. (1894), Sheets 18-24 (pp. 273-368), and Index; Vol. vii. (1895), Sheets 1-2 (pp. 1-32). *From the Museum.*

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DESCRIPTION OF A FLYCATCHER, PRESUMABLY NEW.

By C. W. DE VIS, M.A., CORRESPONDING MEMBER.

ARSES LOREALIS.

Arses sp., with the lower surface entirely white in the male, ochreous in a band on the lower throat in the female, and with white lores in both sexes.

Adult male.—Head, face and ear-coverts glossy black; lore white, with the bases of its feathers black; mantle, wings and rump dusky brown; feathers of the rump tipped with white; tail brownish-black; lesser wing-coverts and upper tail-coverts black; all beneath, cheeks and under wing-coverts, nuchal collar, feathers of lower mantle and scapulars white; thighs dusky-grey; bill black; tarsus and foot dusky horn-brown; orbital wattle blue. Length 147 mm., wing 79, tail 83, culmen 10·5, tarsus 20.

Female.—Head, face, ear-coverts and lores as in the male, but with the black less glossy; mantle, upper wing-coverts and rump brown, the mantle darkened here and there by the dusky centres of the feathers; nuchal collar white, its feathers barred or spotted with black near the tips, scapulars on both webs and the secondaries on the outer web edged with rufous; tail brownish black; beneath, cheeks and under wing-coverts white; feathers of a band across the lower throat broadly tipped with pale buff. Bill paler than in the male. Length 140 mm., wing 77, tail 80, culmen 8·5, tarsus 19·5.

Hab.—Cape York; coll. K. Broadbent, March; habits and haunts similar to those of *A. kaupi*, Gld.

ON THE SPECIFIC IDENTITY OF THE AUSTRALIAN
PERIPATUS USUALLY SUPPOSED TO BE *P.*
LEUCKARTI, SAENGER.

BY J. J. FLETCHER.

In his well known Monograph (p. 153) Mr. Sedgwick remarks that *Peripatus* "was reported from Australia in 1869 by Saenger." It is generally supposed also that this was the first intimation of an Australian *Peripatus*. As a matter of fact there is an earlier notice which has been lost sight of, Professor Leuckart having reported it in 1862.

The second species of the genus to be made known was *P. brevis* with 14 pairs of claw-bearing legs. One specimen was obtained on Table Mountain in 1829, from which De Blainville described the species in 1837. During the stay of the "Novara" at the Cape, Frauenfeld discovered a second South African species of which he subsequently gave a short account in a paper entitled "Aufenthalt am Cap d. g. Hoffnung während der Weltfahrt der k. k. österreichischen Fregatte Novara."* This paper also has been overlooked, nor is it mentioned in the bibliographical lists of either Slater (P.Z.S., 1887, p. 133) or Sedgwick (Monograph, p. 209). It was to his record of this paper that Prof. Leuckart appended his introductory notice of the Australian *Peripatus*.

Frauenfeld says: "Der interessanteste Fund war ein *Peripatus* unter Steinen . . . Wenn nicht in der neuesten Zeit irgendwo beschrieben, ist derselbe jedenfalls neu, da er in der Fusszahl, 17 Paare, mit keiner der wenigen älterbekannten Arten übereinstimmt." Leuckart's short abstract runs as follows: "Frauenfeld beobachtete am Cap der guten Hoffnung eine neue Art des sonderbaren Gen. *Peripatus* mit 17 Paar Beinen. A. a. O. S. 88. (Ref.

*Verh. der k.k. zoolog.-botan. Gesellsch. in Wien, Jahrg. 1860, pp. 77-92.

kann den bis jetzt bekannten Arten dieses Geschlechts gleichfalls eine neue Form aus Australien mit 16 Beinpaaren hinzufügen).*

It is to be noted that in mentioning the Cape species as "mit 17 Paar Beinen,"† Leuckart was simply quoting Frauenfeld, who had seen the animal alive, had witnessed the copious discharge of tenacious slime, "aus dem abgestutzten Ende der beiden kurzen unten den Stirnfühlern liegenden Mundfühlern," and who, therefore, excluded the oral papillæ—as Moseley afterwards called them—when counting the legs. But in regard to the Australian *Peripatus*, it seems evident that Prof. Leuckart intentionally included the oral papillæ among the 16 pairs, but without indicating the fact. For, some years later in noticing Hutton's paper he remarks of *P. novæ-zealandiæ* that like *P. leuckarti*, Säng., it possesses "15 Beinpaare." Now Hutton had expressly said "fifteen pairs of ambulatory legs, and a pair of oral papillæ." Allowing for this, however, there would still seem to have been some misapprehension on Prof. Leuckart's part as to the exact number of claw-bearing legs possessed by his specimen—as the sequel will show.

Subsequently Prof. Leuckart entrusted his specimen of the Australian *Peripatus* to H. Sänger, who embodied a description of it in a paper dealing in some detail with the anatomy of *P. capensis*, contributed to the "Moskauer Naturforscherversammlung" in 1869. Unfortunately Sänger chose the Russian language as his medium of publication, and in consequence his paper for some twenty-five years has been practically buried. Indeed but for two brief references to it by Prof. Leuckart in the *Archiv f. Naturgeschichte*, its existence even, as well as its contents, might very well have remained unknown to this day. The bulky

* *Archiv f. Naturgesch.* Jahrg. xxvii., 1862, ii Bd., p. 235.

† Frauenfeld's specimens were afterwards dealt with by Grube, who described them as *P. capensis* ("Reise der Novara"). He says there were three specimens, two with 17 pairs of claw-bearing legs, the third with 18 pairs. He did not attach specific importance to the difference in the number of legs, whence the "*pedes uncinigeri utrinque 17 vel 18 verrucosi*" of his description.

quarto volume containing the paper bears the date 1870 on the title page, but 1871 on the paper cover. Leuckart's first mention of it was founded on a preliminary notice or abstract in the "Protocollen der Mosk. Naturforscherversamml." He says: "Verf. untersuchte zwei Arten, den *P. capensis*, Gr., und eine neue schon vor mehreren Jahren vom Ref. in diesen Berichten erwähnte neuholländische Art, die vom Verf. als *P. Leuckarti* bezeichnet wird."* Acting on the hint given in this passage I looked through the earlier volumes of the Archiv seriatim until I found the introductory notice, to which reference has been made.

On the publication of the paper itself Leuckart added his oft-quoted second notice,† giving the brief résumé of the characters of the species which has hitherto had to serve as the only available guide to the contents thereof. Leuckart says: "Die neue Art, die aus Neu-Holland stammt, wird folgendermaassen beschrieben: Fünfzehn Paar Füssstumel, von denen das letzte Paar die Geschlechtsöffnung zwischen sich nimmt. Auf der Unterseite der Füße drei Erhebungen, von denen die eine lang und bogenförmig ist, während die zwei andern kurz und gerade sind. Länge 21 mm., grösste Breite 3·05 mm."

This, it will be seen presently, is substantially a translation of the short summary which Sänger added at the end of his description, and from the description itself it is evident that the 15 pairs were intended to include the oral papillæ, though beyond the exceptional use of the suggestive term "Füssstumel" instead of Leuckart's more usual expressions "Beinpaaren" or "Paar Beinen," no intimation of this is given in the summary or the translation. When the context is not left out of account the summary is quite satisfactory; wholly detached there from it is not free from ambiguity. When Peripatus was rediscovered in Australia, and all the specimens forthcoming for some time were found to possess 15 pairs of walking legs, a wrong interpretation was put on the expression "15 Paar Füssstumel" of Leuckart's

*Arch. f. N. xxxv. Jahrg. ii. Bd. 1869, p. 277.

†l.c. xxxvii., ii. Bd., 1871, p. 407.

abstract. Forthwith naturalists took Sanger's name, unwittingly but unwarrantably fitted it out with new characters, and all the time thought they were strictly following the leader, or only legitimately supplementing his work. Fortunately nothing very much worse has resulted than some considerable confusion of nomenclature, which has not however passed beyond the bounds of rectification,

Sanger's paper has seemed in danger of permanent consignment to oblivion; all the more so, perhaps, under the delusion that of late years observers had supplemented what little was known of it with all that was necessary for the exact identification of the species. It happily occurred to Prof. Spencer when on a visit to England recently, that the satisfaction of knowing exactly what Sanger had said on the subject might possibly prove to be sufficient compensation for the expenditure of the trouble necessary to get at it. He therefore took the matter earnestly in hand, and with the co-operation of Prof. Howes, Mr. H. M. Bernard, and a friend of the latter's, he at length became possessed of a translation of that part of Sanger's paper descriptive of the Australian *Peripatus*. I have to thank Prof. Spencer not only for a copy of the translation, but also for his permission to make use of it. Before considering the translation, one or two other matters may be noticed.

Some years before the re-discovery of *Peripatus* in Australia, the New Zealand species came to light. During the stay of H.M.S. "Challenger" at Wellington in July, 1874, Mr. Travers brought specimens to Mr. Moseley, who says that he was unable to refer to special publications at the time, and he thought that it was "already certainly named;" afterwards on his return to England press of work prevented his giving further attention to the matter. Very shortly after it came under Grube's notice, who refers to it in a paper read in 1875. I am unable to consult this paper* which is thus noticed by Leuckart: "Grube

* Ber. der schles. Gesellsch. f. Cultur u.s.w. aus dem Jahre 1875. Naturwiss. Ber. S. 52.



berichtet über zwei Peripatusarten, von denen die eine, aus Neu-Seeland, mit *P. Leuckarti*, Säng., stimmt, die andere aber unter der Bezeichnung *P. peruanus* neu beschrieben wird.”* Captain Hutton says that he sent specimens to Dublin, without any result. Finally in 1876, Hutton himself described the species as *P. novæ-zealandiæ*. Now at this time Hutton evidently was unaware of any record of an Australian Peripatus; nor, under the circumstances, is that at all surprising, seeing that he was at least as badly off for literature as Moseley during the “Challenger’s” visit to Wellington. Of Hutton’s paper Leuckart remarks:—“Hutton’s Abhandlung ‘On *Peripatus novæ-zealandæ*’ (Ann. Mag. Nat. Hist. (4) xviii., Nov., 1876, pp. 361-369, Pl. xvii.) macht uns mit einer Form bekannt, die 15 Beinpaare besitzt, wie der von Säng. (J.-B. 1870, S. 410) beschriebene *P. Leuckarti*, der unserm Verf. freilich unbekannt geblieben ist, obwohl seine neue Art vielleicht damit zusammenfällt. Jedenfalls ist nicht der *P. novæ-zealandiæ*, sondern der *P. Leuckarti* die erste Art des Gen. *Peripatus*, die aus Australien kommt.”†

When it is borne in mind that at this time only a single specimen of the Australian Peripatus was known, and that a female‡ whose jaw blades were not examined, Sänger not being at liberty to dissect the unique example at his disposal; also that, even in the light of up-to-date knowledge the most striking differences between the allied Australian and New Zealand species—*P. insignis*, Dend., being left out of consideration for the present—are furnished by the outer jaw blades, and the secondary sexual characters of the males, it would be interesting to know more definitely what it was that suggested the agreement between or possible identity of the two species. Perhaps Grube’s paper would settle this point. Was it that too little was known for accurate

* Arch. f. Naturgesch. Jahrg. xliii., 1887, ii. Bd. p. 510.

† *L.c.* p. 509.

‡ The sex of the type specimen is not mentioned in the description; but in Sänger’s fig. 31 the genital aperture is lettered *vl.*, just as in his fig. of an undoubted female of *P. capensis*.

comparison; or was it that the authors mentioned thought that in each case the number of claw-bearing legs was the same: or that they knew that the numbers were not identical but regarded the difference as not of specific importance? Moseley's remark penned in 1879, "In the Australian and New Zealand species the number of feet seems fixed"—would, under the circumstances mentioned, seem without force if the last condition held.

On the re-discovery of the Australian *Peripatus*, first in Queensland (in 1886)—not improbably first in Tasmania, though no record of it was made at the time—then in Victoria (in 1888), and in the same year in New South Wales, and all the specimens met with for several years were found to have 15 pairs of walking legs, it was imagined that these were correctly identified as *P. leuckarti* in supposed agreement with the "funfzehn Paar Fussstümel" of Leuckart's abstract of Säger's paper. In 1890 Dr. Dendy met with a Victorian *Peripatus*, with 14 pairs of walking legs, and without an accessory tooth at the base of the fang of the outer jaw blades; and this he quite justifiably considered to be sufficiently distinct to be regarded as a second Australian species, which he accordingly described as *P. insignis*. In 1892 Prof. Spencer obtained similar examples in Tasmania.

We may now turn to

"Säger's original Diagnosis of Peripatus Leuckartii."

"Found in New Holland, north-west from Sydney. Fifteen pairs of legs, one pair without claws, fourteen with. This character also found in *P. brevis*, described by Blanchard. 21 mm. long. Sexual opening between the last pair of appendages, herein differing from *P. Edwardsii* and *P. capensis*. Colour very nearly black dorsally, greyish ventrally. Papillæ distributed dorsally and ventrally: those on the ventral surface, however, are longer and stand outwards laterally. Between each pair of appendages is a light oval spot without papillæ; this spot corresponds with the dark pits in *P. capensis*, under which occur the glands already described. The papillæ, as in *P. capensis*, are either small and black or large and red, but there are more black than red. Along

the back runs a longitudinal median line, which consists only of black papillæ, but this line is comparatively faint. The papillæ along the back are arranged in fairly accurate transverse rows, and each row is separated from the next by a furrow. The skin between the papillæ is dark grey. The papillæ on the legs are fairly wide apart. The legs have "soles," which, as in *P. capensis*, consist of three segments, but the shape of these segments is very different from those of *P. capensis*. The first proximally is black and strongly curved and considerably narrower than the following. The second and third segments are reddish yellow and much shorter but broader than the first. The claw-bearing joint which follows these segments, is distinguished by its four-cornered appearance, due to a pair of papillæ at its outer corners, one on each side (*P. capensis* has three papillæ). The claws are smaller than those of *P. capensis*. The structure of the mouth is the same as that in other genera [? species] only the soft parts surrounding the mouth and sexual organs are white and not yellowish, but this may be due to the action of alcohol. In addition to this description of the outer appearance of the animal, I give the more important dimensions of the described specimen. Body length 21 mm.; greatest breadth 3.03 mm.; length of antennæ from 1.6 to 1.73; width of antennæ at base 0.389; in the middle of antennæ 0.26; length of the oral aperture, including the soft parts surrounding it, 0.952; length of the legs from the top 2.16; width at base 0.86, but this varies; length of claw-bearing joint 0.26; diameter of sexual opening with soft parts surrounding it 0.65; diameter of eye 0.11; diameter of papillæ from 0.04 to 0.08; length of claw 0.15; width of same at base 0.105."

"This specimen is in the possession of Professor Leuckart after whom I have named it by permission. A short diagnosis may be given as follows: fifteen pairs of legs; sexual organs between last pair; the "sole" consists of three segments, one long and curved, and two short and straight. New Holland, Australia."

By way of comment on the above it may be remarked:—

(1) Though neither the exact habitat, nor the name of the collector has yet transpired, "North-west from Sydney" is some-

what less unsatisfactory than New Holland. I should take it to mean that the type specimen was found within the limits of New South Wales, somewhere between Sydney and Cassilis—at which place Mr. Olliff obtained the otherwise first recorded specimen from this colony—or thereabouts, but not much further to the west or north-west of the latter. It is hardly probable that over thirty years ago *Peripatus* was found in the then newly separated colony of Queensland at any spot in a direction N.W. from Sydney, say to the north of Bourke. Not only would such a locality then have been very much less easy of access to a zoological collector than it is now; but it would, I should think, be one with a climate altogether too dry for *Peripatus*. This being so, it is a curious fact—not however without a parallel,—that so long ago somebody should have casually found somewhere in this colony a single specimen of *Peripatus* with 14 pairs of walking legs, but that similar specimens, whether from New South Wales or Queensland, notwithstanding much collecting, should still be desiderata. Sedgwick has probably had to do with more individual specimens of *Peripatus* than all other naturalists put together; and yet among the specimens—“more than a thousand from the Cape Peninsula”—which came under his notice, *P. brevis*, de Blainv., was conspicuously absent, and in the flesh was unknown to him at the time the Monograph was written. In the Macleay Museum is a specimen of a *Peripatus* with 15 pairs of walking legs, labelled Tasmania, to which Mr. Masters directed my attention in 1890 (P.L.S. N.S.W., 2nd Ser., Vol. v., p. 469). At that time Mr. Masters considered that it had been at least ten years in the collection, and he still thinks that the correctness of the reputed locality is not open to question. The label is in his own writing, but he is unable to recall the exact circumstances under which the specimen came to hand. Recently Prof. Baldwin Spencer was successful in finding *Peripatus* in Tasmania, but some fifteen specimens obtained had 14 pairs of claw-bearing legs apiece.

(2) It was not Prof. Leuckart's intention to furnish a technical description of his specimen. On the other hand Sängner's description was about as full as it could be expected to be under the

circumstances; the situation of the genital aperture, the number of the spinous pads (soles), and the arrangement of the primary papillæ on the claw-bearing joints of the legs, all being duly noted. Moreover, he gives six figures of various parts of the specimen. His examination of it was therefore of a more or less minute character, and it is hardly possible that he should have incorrectly counted the number of the walking legs.

(3) The only reference to the description of *P. brevis*, de Blainville, [not Blanchard] given by Selater and Sedgwick—besides de Blainville, "Dictionnaire des Sciences Naturelles," Supplement, T. i., p. 237, Paris, 1840, which I am unable to consult—is the footnote to Gervais' paper "Etudes pour servir à l'histoire naturelle des Myriapodes" in the Ann. Sc. Nat. (2), vii., p. 38, 1837. This, however, is but the abbreviated description, quoted by Sedgwick (Monograph, p. 168), which mentions "pourvu de quatorze paires de pattes," but does not disclose what view de Blainville took of the oral papillæ, nor exactly what the fourteen pairs were to be understood as comprehending. In Gervais' paper "Sur le Genre Peripate"* is incorporated a detailed description

* Ann. Françaises et Etrangères d' Anat. et de Physiol. T. ii. p. 309, 1838. Abstract in Revue Zoologique, par la Soc. Cuvierienne, Année, 1838, pp. 264-265.

In the same paper (pp. 314 and 310) Gervais says "celui qu' a vu M. Macleay étrait de Cuba," having previously stated "et M. Macleay, qui en parle d' une manière transitoire dans un note publié depuis plusieurs années, dit aussi qu' ils ont des rapports avec les vers et en même temps avec les Myriapodes (Zoological Journal)." Sedgwick (*l.c.* p. 197) remarks, "Blanchard refers to a *Peripatus* found in Cuba by Mr. Macleay. He regards it as belonging to the species *juliformis*. I have been unable to find any account of this Cuban species."

The only reference to *Peripatus* by W. S. Macleay I can find in the Zoological Journal is contained in a postscript to a letter written from Havanna to Mr. Vigors (Vol. iv. p. 278). It takes exception to Guilding's view of *Peripatus* as a mollusc, suggests other affinities, and adds "There is a specimen in my father's collection" [at that time in Australia]. But it seems to me to offer no ground for associating the record of a Cuban species with W. S. Macleay's name.

of *P. brevis* communicated by de Blainville, and given in his own words. From this it appears that the "quatorze paires de pattes" has reference only to claw-bearing legs. The oral papillæ he thus describes—"Quant aux appendices: la tête est pourvue d'une paire de tentacules simples. . . . On remarque à la partie externe de leur base, et par conséquent de chaque côté, un stemmate ou un point pseudo-oculaire formé par un petit disque cordé, un peu convexe et simple." Upon this Gervais remarks: "M. Wiegmann considère comme des pattes atrophiées les deux organes que MM. Guilding, de Blainville, Audouin et Edwards signalent comme des yeux."

(4) There is nothing remarkable about the colour of the specimen. I have seen specimens (with 15 pairs of legs), from Queensland and New South Wales, which might be described in very similar or identical terms.

(5) I do not understand the statement that "the claw-bearing joint which follows these segments [spinous pads], is distinguished by its 4-cornered appearance *due to a pair of papillæ at its outer corners, one on each side* (*P. capensis* has three)." The statement as to *P. capensis* is borne out by Sängers figures; and both are in harmony with the quite independent observations and figures of Sedgwick, who says that there are two primary papillæ on the front or anterior side of the distal end of the foot, close to the socket in which the claws are placed, and one on the posterior side. In the Australian and New Zealand species the distal end of the foot also has three primary papillæ, but they are differently arranged, one being anterior, one posterior, and one median and dorsal. At least two of his figures (figs. 32, 33 and perhaps 34) show that Sängers correctly recognised this character in the Australian *Peripatus*. His fig. 35 is certainly very satisfactorily 4-cornered, three of the corners being furnished by the three papillæ in question, while the fourth is apparently an equally conspicuous similar primary papilla which is median and ventral; but with which the Australian *Peripatus* has not been credited by any other observer. Even so, the statement "a pair of papillæ at its outer corners, one on each side," hardly seems to express

this arrangement very intelligibly. What I find is a pair of elevations at the distal end of the ventral aspect, one on each side of the median line, and each of them without about two spines; they are comparable with the similarly situated but more extensive groups of "inconspicuous pale elevations, bearing spines" in *P. capensis* referred to by Sedgwick (*l. c.* p. 163). Sängér, too, noticed them in that species, but in his fig. 5 they are represented like a pair of primary papillæ, each bearing one spine.

Since then the type of *P. leuckarti*, Säng., has 14 pairs of walking legs, a question which naturally offers itself for consideration is—how ought the common, more widely distributed Australian Peripatus with 15 pairs of walking legs to be designated? Some months ago I had the opportunity of discussing the question with Dr. Dendy in the light of Prof. Spencer's translation. As the variation in the number of claw-bearing legs, as far as was then known, appeared to be correlated with a variation in the character of the outer jaw blades it seemed not unreasonable to regard the Peripatus with 15 pairs of walking legs as distinct from *P. leuckarti*, Säng., and entitled to a new name; Dr. Dendy even considering himself justified in regarding the larger Victorian Peripatus as sufficiently distinct from that of New South Wales to merit independent specific rank. And we intended to act accordingly.

Quite unexpectedly, only last week, I received from Mr. A. M. Lea, of West Australia, a small consignment of specimens from that colony, the examination of which, as it seems to me, throws important light on the question propounded above, and has compelled me to modify my views. Each of five specimens has 15 pairs of walking legs, and the jaw-blades removed from one of them are without an accessory tooth at the base of the fang of the outer blade. Under the old régime it would have seemed to be a moot point whether they should be called *P. insignis*, Dendy, var. with 15 pairs of legs, or *P. leuckarti*, Sängér, var. without an accessory tooth; indeed in the absence of males they might almost have been referred to *P. novæ-zealandiæ*, Hutton. If the

eastern form is to be regarded as a species distinct from what we must now consider to be *P. leuckarti*, Säng., then the western form also, as it seems to me, ought to be so regarded. I would prefer to consider the latter an intermediate form, as at present Australia would, I think, be over-supplied with as many as four species. Seeing that many more specimens have had their legs counted, than have had the jaw blades examined, and that in two examples from New South Wales, in one or both outer blades there is more than one accessory tooth,—in one case three on the jaw blade of one side; in another the accessory tooth, longer and blunter than usual, is followed by several serrations; in both examples the peculiarities are reproduced in the reserve teeth—it seems probable that unlooked for variation may be found. Further, Dr. Dendy has recently recognised as a var. of *P. novæ-zealandiæ* a New Zealand *Peripatus* with 16 pairs of walking legs*; so that the idea that in this species the number of feet is “fixed,” must now be given up. Therefore the most satisfactory arrangement, in my opinion, would be to consider all the known Australian specimens of *Peripatus* as referable to one comprehensive species with four varieties as follows:—

PERIPATUS LEUCKARTI, Säng.

With 14 or with 15 pairs of claw-bearing ambulatory legs. Outer jaw-blades without or with an accessory tooth, occasionally more, at the base of the main tooth. Males smaller than the females; with a pair of (accessory gland) pores close together, situated between the genital papilla and the anus; with a white or sometimes bluish tubercle—on which opens the crural gland—on each leg of the first pair only, or of the last pair only, or of all or only some of the pairs with the exception of the first, or of the first five.

Colour varying from dark blue or almost so, so dark sometimes as to appear blackish, with a still darker median dorsal line in the centre of which lies a fine unpigmented groove; to alternate

* Ann. Mag. N. H. (6) Vol. xiv., Dec. 1894, p. 401.

longitudinal stripes of blue and orange or their equivalents—three of the former and four of the latter; or red with two of the dark stripes represented only by blackish blotches and discontinuous irregular patches. With an interesting series of more or less gradational colour-varieties arising from some modification of the following pattern: the dorsal surface is a mosaic of three longitudinal series of roughly hexagonal or lozenge-shaped areas outlined in dark upon a lighter background, bordered on each side by a light longitudinal stripe immediately above the insertion of the legs; the lozenges of the median series are confluent, the boundaries between them having disappeared, they correspond with the legs, and down the middle of the series dividing it symmetrically is a dark—blue, black, or rarely red—line often presenting as it were a knot-like enlargement in the middle of each lozenge, the dark line having down the centre of it a fine unpigmented sometimes interrupted groove. From the relative proportions of blue and orange or their equivalents present, from the partial or more or less complete disappearance of the dark reticulate pattern, or from the subdivision of the median series of lozenges into two sets of four-sided or diamond-shaped areas result some very interesting and, without a series for examination, sometimes very puzzling combinations. The legs sometimes appear as if inserted on a dark longitudinal stripe. The colour of the ventral surface is paler, but not less varied than that of the dorsal surface; generally speaking, it presents shades of the predominant tints of the dorsal surface. A discontinuous median series of small pale areas devoid of papillæ down the middle of it (ventral organs), one or sometimes two to each pair of legs.

As in *P. novæ-zealandiæ*, the generative opening is between the legs of the last pair; the claw-bearing legs have three spinous pads; and a primary papilla projects from the median dorsal portion of the foot.

Hab.—In suitable situations in the table-land and coastal regions of Queensland and New South Wales, widely distributed but not abundant; Victoria; Tasmania; and West Australia.

1. *P. LEUCKARTI*, Säng., var. *typica*

P. leuckarti, Säng., non auct.: *P. insignis*, Dendy, Vict. Nat. Vol. vi. No. 12, April, 1890, p. 173; Spencer, Proc. Roy. Soc. Vict. 1894, p. 31.

With 14 pairs of claw-bearing legs; outer jaw blades without an accessory tooth.

Hab.—New South Wales, Victoria, Tasmania.

The re-discovery of this variety in New South Wales is a matter to be desired, as the jaw characters of the type are unknown. I have seen only Tasmanian specimens—six (three of each sex) kindly lent me by Prof. Spencer. Two of them are dark without any definite pattern; the others have more orange red and show a dark median line with nodosities, not always opposite the legs, and a pattern of secondary diamonds, much like some N.S.W. specimens of var. *orientalis*. The males are remarkable by the absence of white tubercles from the legs of the first five pairs; they are present on all or nearly all the others.

2. *P. LEUCKARTI*, Säng., var. *occidentalis*, var. nov.

With 15 pairs of walking legs; outer jaw-blades without an accessory tooth.

Hab.—Bridgetown, inland from Perth, W.A. (Mr. A. M. Lea).

The specimens, which were put straight into spirit, are small (the largest but slightly exceeding 15 mm.) even allowing for the contraction due to the method of preservation. There is nothing specially remarkable about the coloration, which is mainly blue, with a smaller amount of orange. They would pass muster in this respect very well among a collection of similarly preserved eastern specimens.

The males have white papillæ on most of the legs, but not on those of the first pair. One of the females obtained and preserved on March 30th last contained about ten advanced embryos varying slightly in age, of which the proximal one has the body more pigmented than is usually the case with the newly born young of the eastern form. As in the latter, the embryos are contained

within a thin hyaline membranous shell. The breeding season, at any rate as to its termination, would seem to be in agreement in the two cases.

Several living examples forwarded at the same time, unfortunately in the same enclosure as the spirit specimens, miserably perished on the journey.

3. *P. LEUCKARTI*, Säng., var. *orientalis*.

P. leuckarti, Säng., of authors, but not of Sängers; nor the larger Victorian *Peripatus* of Dendy.

With 15 pairs of walking legs; outer jaw-blades with one accessory tooth or with several. Length of largest specimens extended after drowning—♀. 50 mm.; ♂. 29 mm. (the antennae being excluded).

Hab.—[Queensland*]; New South Wales (not yet found west of the Dividing Range).

I now possess a fine series of specimens from this Colony, but it does not include a single specimen normally with 14 pairs of claw-bearing legs. Of one specimen the legs of the fourteenth pair are without claws, while the fifteenth pair is represented by a pair of small white symmetrical stumps, between which, however, the generative aperture is placed: I should suppose that this specimen was recovering from some injury to the hinder end of the body. I have several times seen a specimen with one leg on one side missing.

My series presents a very remarkable variety of colour and pattern. The specimens might very well be sorted out into something like ten distinguishable, but more or less gradational, lots. If the whole of the median series—with the exception, of course, of the very dark median line—be filled in with red, the mosaic of lozenges then becomes very distinct, as in that case the

* My remarks must be understood as applying more particularly to the *Peripatus* of New South Wales, as I have had the opportunity of examining only a few Queensland specimens (♂'s), and no observations on the breeding habits of the Queensland *Peripatus* are known to me.

stripes above the legs will be almost entirely red, contrasting well with the intervening series. Interesting variations of this pattern arise by the partial filling in of the lozenges of the median series; the red may be aggregated in a little patch on each side of the nodose enlargement on the median dark line, or it may just fill in the lateral apices of each lozenge. The most complicated pattern arising from a secondary arrangement of (four-sided) diamonds may be described as follows: Two lines intersecting in each nodose enlargement of the median dark line cut off from a lozenge a pair of small diamonds, one on each side of the median line corresponding with the legs; and an anterior and posterior portion which, with the posterior portion of the lozenge preceding, and the anterior of the succeeding one, make up two of a single median interrupted series of larger diamonds, each of which corresponds with the interval between the legs*: the former are sometimes filled in with red; the latter partially. Sometimes the dark boundaries disappear, leaving only the patches of red. The light longitudinal stripe above the insertion of the legs is usually very distinct, but sometimes there are only indications of it, or it is a discontinuous series of orange or red patches above the intervals between the successive legs of each side. Its light tint may be due to the presence of light blue both in the ground colour, and on the primary papillæ with the exception of their summits.

I have seen only a very small series of the larger Victorian *Peripatus*, but as far as it goes the following slight differences attract my notice. The median dark longitudinal line is either wanting or is not so marked a feature as in our variety; and the unpigmented median groove is rather more conspicuous. The line of demarcation between the median and each lateral series of the mosaic is better defined; that between the lateral series and the longitudinal stripe is not, I think, quite so definite. The longitudinal stripe above the legs, except in specimens with a very large amount of red, is not so clearly indicated as is usually

* That is, the interval between two consecutive legs of the same side.

the case in ours. These differences, however, are not more striking than those which may be presented by a number of individual specimens from New South Wales found in the same log.

Such slight local variations, as well as in the secondary sexual characters of the males, are not uncommon. I have had a good deal of experience now with the *Peripatus* of New South Wales, but I never yet met with longitudinally striped examples such as Mr. Helms got at Mt. Kosciusco, and Mr. Lea on the northern Tableland. On the other hand, some of my own examples are unlike any I have seen among those collected by others in localities which I have not myself visited. From one district my specimens are characterised by a red tail. Illawarra specimens commonly have a well-marked nodose median dark line, each nodosity standing in a rather triangular patch of red, but with little or no indication of a lozenge pattern; and in these specimens the median ventral series of white patches (ventral organs) are very inconspicuous indeed. It was such specimens as these that first came under my notice; and the relation of their colour-pattern to the diamond pattern of the Victorian *Peripatus* described by Dr. Dendy failed to suggest itself. I have now examples from other localities in New South Wales which show the chequer pattern as characteristically as Victorian examples.

The males usually have papillæ on all or most of the legs after the first pair, but among specimens from one district I find males with papillæ on the legs of the first pair only to predominate, though in two other examples there is also an additional papilla on one leg of the second pair. In the first case crural glands appear to be absent from the legs of the first pair; and of the remainder when papillæ are wanting on some of the legs crural pores may still be recognisable. In the second case crural glands seem to be present only in the legs of the first pair—rarely an additional one in one leg of the second pair. I have seen at least thirty males with papillæ on the legs of the first pair only. Two of these Mr. J. P. Hill,

Demonstrator of Biology, Sydney University, very kindly sectioned for me. The legs did not all cut in an equally satisfactory manner; but allowing for this, beyond a large pair of crural glands in the two papilla-bearing legs, I can see no indication of their presence in the others. I have not seen any specimen with papillæ on the legs of the last pair only. When papillæ are present on the legs of the last pair they are situated nearer the base of the leg than in the case of the others. This, however, is because the legs of the fifteenth pair are shorter, and consequently have fewer transverse papilla-bearing ridges. The papillæ still occupy the normal portion—namely, on about the fifth papilla-bearing ridge above the innermost spinous pad.

In a previous paper (P.L.S.N.S.W. 2nd Ser. v. p. 484) I referred to the presence in some females of longitudinal slit-like depressions or pores situated a little below the nephridiopores, and suggestive of rudiments or relics of crural glands. They are not, however, the representatives of the crural glands of the males, for I now have specimens of the latter, both with numerous crural papillæ and with only one pair which show the same character. In the males they are situated between the nephridiopore and the papilla when present, or the position it would occupy if present. Occasionally, even in the females, a little white coagulated secretion is left in the aperture. Unless these represent a second series of crural glands which were possessed by both sexes, but are now becoming more or less aborted, I do not at present know what they can be.

The ova are large, and have a considerable amount of yolk. As in *P. capensis*, the egg-shell is a thin transparent membrane; not a thick chitinous covering as in *P. novæ-zealandiæ*, and in the larger Victorian *Peripatus*.

There is some difference in detail in respect of the breeding habits of the New Zealand *Peripatus* and that of New South Wales as known to me; and in neither case is it so easy, as in that of *P. capensis*, to fix definitely the length of the period of gestation, or the exact limits of the breeding season; and, I should imagine, for a similar reason.

Of *P. capensis*, Sedgwick says: "The period of gestation is thirteen months; that is to say, the ova pass into the oviducts about one month before the young of the preceding year are born. . . . The young are born in April and May" (Monograph, p. 165).

Of *P. novæ-zealandiæ*, Captain Hutton says that it appears to breed all the year round; and that he found the uterus crowded with embryos in September and November. The views of Mr. Sedgwick and Miss Sheldon are summed up by the latter as follows:—"Probably the ova pass from the ovary into the uterus in December, and the young are born in July, the development thus occupying a period of about eight months. This, though apparently usually the case, cannot be universal, since in each lot there were one or two females which contained embryos ready for birth, and also the embryos in one female vary somewhat in age."

Slater, therefore, hardly satisfactorily states the case when he says of both the South African and the New Zealand Peripatus that "the development of the embryos, though going on all the year round, commences at one particular season, so that all the embryos found in the uterus of the female are approximately of one age." (Studies from the Morph. Lab. Cambridge, Vol. iv. p. 215, 1889.)

Of the Neotropical species, Sedgwick remarks:—"Embryos of very different ages in same uterus, and births probably taking place all the year round"; and of *P. Edwardsii*—"The uterus contains embryos in all stages of development, and the young, which are fully developed at birth, are presumably born at different times of the year." (Monograph, pp. 184 and 190.)

The Australian Peripatus with which I am familiar seems in these matters to occupy an intermediate position between *P. capensis* and the Neotropical species. If one cannot say of it that it breeds all the year round, or that the uterus contains embryos in all stages of development, still less can one definitely particularise any single month as par excellence the breeding season; or assert that embryos of approximately one age only are to be found in pregnant specimens. And, so far as I can judge,

I should think the New Zealand *Peripatus* is not widely different in this respect from ours.

I have examined females of the common *Peripatus* of New Wales at intervals during the greater part of the year. There are still a few important blanks in my series when certain details are wanted, which I hope soon to be able to fill. I shall, therefore, postpone a full consideration. But I have seen enough to show the general trend of matters.

Of the first lot of specimens I ever had, one specimen was kept from June 16th to the last week in October: a few days before her death she produced four young ones. In July an embryo which had about half completed its development was removed from another female of the same batch, and preserved by Professor Haswell. I still have this specimen.

In 1892 I had specimens under observation from April until the following March; the first young one was noted on November 11th.

In 1893 I got a fine series in the last week of July. A single unusually early young one was noticed on August 15th. A few others were noticed on September 22nd. By November the females were breeding freely, sixty young ones being noted on November 22nd. From 15th-18th of August seventeen females of this batch in process of being drowned extruded 83 young embryos (from 1-14 each): these vary slightly in age, and comprise specimens at about the same stage, and also at a little more advanced stage, than the New Zealand embryo figured by Miss Sheldon (*Studies*, Vol. iv. Pl. xxvi. figs. 25-26); that is to say, the longitudinal ridge along each side of the body from which the appendages take their origin, shows rudiments of from about half a dozen pairs to nearly the full number. During the following week three females were opened; they contained 23, 30 and 37 very similar stages, together with younger ones and a few ova. In the first week in October five females of the same lot when being drowned extruded eight embryos; these are much more advanced than those extruded six weeks earlier, the full number of claw-bearing legs being present. The following week two

females were opened; each of these contained about 39 very similar old embryos, a few of the proximal ones having the tentacles noticeably pigmented.

Two lots obtained early in January at the same locality in different years began to produce young towards the end of the month, young being especially numerous during February.

On April 2nd, 1893, I obtained a small batch of specimens; within the next fortnight six young ones were observed.

I have seen newly-born young in every month from August (only one specimen) to the early part of May. I have never seen them during the latter part of May, or in June and July, and in August only one surprisingly early specimen; and I should be surprised to find our *Peripatus* breeding during the winter months. Thus, while it will be seen that according to my experience, one cannot say of our common New South Wales that it breeds all the year round, yet it certainly does during the greater part—about three-fourths—of the year. The majority of the young I should say were born during a period of six months—say from October to March; but the progeny of a few early breeders and a few late breeders add another three months. But if it cannot be said to breed quite all the year round, still less can any particular month by itself be selected as the breeding season. And as to the contents of the uterus, I do not find in the same female embryos in all stages of development, nor yet embryos which are all of the same age.

The earliest date at which I have happened to examine females containing ova which had recently passed into the uterus is about the middle of April; the latest about the middle of October. In both cases, as well as in a female opened in the first week in August, there were also enlarging ovarian ova in various stages. Further observations will, I have no doubt, slightly extend this period during which at intervals ova mature and pass into the oviducts. From about the middle of March, or in exceptionally early cases towards the end of February or beginning of March, to about the middle of November or

exceptionally a little later, will very probably prove to be not very wide of the mark.

If the unusually early August young one referred to above was developed from an ovum which passed into the oviduct about the middle of February; the October young from April ova; and the young born towards the end of April or early in May from ova which left the ovaries in October or November preceding—as may very well have been the case—then the period of gestation is about six months; not less, probably a little more; but from 6-7 months will, I believe, prove to be a very close approximation to the truth.

The largest number of New Zealand *Peripatus* embryos met with by Captain Hutton was 26 (18 + 8); by Mr. Sedgwick or Miss Sheldon 18 (12 + 6). The largest number I have found in our *Peripatus* is 53, in a female opened on November 21st. They form a finely gradational series of old embryos—the youngest with claw-bearing legs, the proximal half dozen or so with pigmented tentacles. Females with from 30-40 embryos or ova are not uncommon in certain months.* Whether the contents of the uteri show any very marked differences in the stages of development reached depends a good deal on circumstances. About the time when the breeding season usually ends one may find females containing a few old embryos not differing very noticeably, or nothing, or a few old embryos together with a few ova which have recently passed into the uteri, or only some of the latter. Still later in the season one may find an increased number of young embryos together with fresh ova. But my experience is that if the contained series is a large one, as a rule it presents no very abrupt breaks, but one gets a finely graduated series of old or of

* On the other hand, when the supply of material has been short, and small and therefore young specimens—possibly even commencing to breed for the first time—have had to be utilised, the numbers have been very small compared with what might be expected to occur in large examples opened at the same time of year. In two such cases the numbers were only two and one respectively.

young stages varying slightly in age. Also that in different females one may find at different times of the year separated by an interval of as much as six months embryos at the same stage of development.

On several occasions I have found a few embryos which had been prematurely extruded by females living in captivity.

[4. THE VICTORIAN PERIPATUS TO BE DEALT WITH BY
DR. DENDY.

Hab.—Victoria and Tasmania (probably—for a specimen in the Macleay Museum)].

DESCRIPTION OF *PERIPATUS OVIPARUS*.

BY ARTHUR DENDY, D.SC., PROFESSOR OF BIOLOGY IN THE
CANTERBURY COLLEGE, UNIVERSITY OF NEW ZEALAND.

In my presidential address to the Biological Section of the Australasian Association for the Advancement of Science, at the meeting recently held in Brisbane, I pointed out certain facts which had lately come to light with regard to the literature of the Australian species of *Peripatus*, and which might render necessary certain alterations in the nomenclature. At the same time I still refrained from attaching a specific name to the oviparous Victorian species, pending further evidence. After my address was written I had the opportunity of talking over the matter with Mr. J. J. Fletcher in Sydney, and found that he had independently arrived at conclusions very similar to those contained in my manuscript. Mr. Fletcher suggested that we should each contribute a paper on the subject to the next meeting of this Society, and that in my contribution I should confine myself to the egg-laying Victorian species, which we agreed should now receive a name. In accordance with this suggestion I now submit a description of the species in question, for which I propose the name *Peripatus oviparus*.

Very fortunately, while I was in New South Wales, my friend Mr. Thos. Steel, F.C.S., was successful in finding a large number of the viviparous species with fifteen pairs of claw-bearing legs. These I was able to examine both alive and by means of dissection, and I have thus satisfied myself that the oviparous Victorian form is certainly worthy of a distinctive name.

PERIPATUS OVIPARUS, n.sp.

Peripatus leuckartii (probably in all cases where this name has hitherto been applied to specimens from Victoria with fifteen pairs of claw-bearing legs, especially in earlier papers of the present writer, but not where the name has been applied to specimens from New South Wales).

A good-sized female specimen, when crawling, measured 39 mm. in length, exclusive of the antennæ. Full-grown females preserved in spirit and contracted in the usual manner (not extended by drowning) measure about 20 mm. in length (exclusive of the antennæ) by 4.5 mm. in greatest breadth (exclusive of the legs). The males seem to be commonly somewhat smaller than the adult females, but the evidence at present forthcoming is not sufficient to justify a generalization on this point.

There are fifteen pairs of claw-bearing legs. Each leg has three pale-coloured spinous pads on its ventral surface. On the fourth and fifth legs the proximal and largest pad is divided transversely into three parts, the median part being much the smallest and bearing a white papilla. Each foot bears three large primary papillæ, one anterior, one posterior, and one dorsal, overhanging the pair of claws.

The jaws consist as usual each of two blades, the inner blade has about seven teeth and the outer one consists of a single well-developed tooth with a very small accessory tooth at its base.

The integument is as usual transversely furrowed, with rows of papillæ of varying size on the intervening ridges. Along the mid-dorsal line there is a deep narrow groove; the integument lining the floor of this groove is devoid of pigment and thus gives rise to a very narrow median white line, which may be hidden by contraction.

The predominant colours of the skin are red and indigo blue, the former passing into yellow and the latter into black in some specimens. The characteristic pattern of the dorsal surface consists chiefly in a series of segmentally arranged, diamond-shaped patches in which the red colour is predominant. Each

patch is made up of two triangular halves whose bases face one another on each side of the mid-dorsal line, while their apices lie over the legs and at about one-third of the distance from the mid-dorsal line to the insertion of the legs. The separation of the diamonds from one another is by no means complete, so that there are two continuous bands of red, one on each side of the mid-dorsal line, the outer margins of which bands are deeply indented. The edges of the mid-dorsal groove are commonly darkly pigmented, and may give rise to an apparently single median dark line when the lips of the groove are closed together. There is commonly also a dark edging to the red diamonds, forming a zig-zag longitudinal stripe. This typical pattern may be almost if not quite obliterated by the replacement of the red pigment by the dark indigo blue; but even in very dark specimens it may still be represented by a row of small, pale yellow or red spots, each occupying the position of the apex of one of the red triangles in typical specimens. The ventral surface is paler than the dorsal, and there is in the middle line a row of still paler areas placed one between the legs of each pair but the last. Patches of dark indigo blue are usually present on the under surfaces of the legs near to their bases.

In the adult female, in place of the usual genital papilla, there is a very conspicuous organ which may be called an ovipositor. This, when contracted, is an ovoid body of a pale yellow or orange colour, projecting backwards from between the legs of the last (15th) pair. In adult specimens ordinarily contracted in spirit the ovipositor is as large or larger than the legs between which it lies. It is, however, capable of great extension. Its surface is uniformly ornamented with minute, spine-bearing papillæ, and at its apex it bears a large slit placed parallel to the long axis of the body of the animal.

The internal reproductive organs of the female are arranged as follows:—The ovary consists of right and left halves united in front and behind and attached by a mesentery to the pericardial septum in the mid-dorsal line. The oviducts are long and convoluted; they have a common origin from the posterior end of the

ovary, to which they are attached. Near to its point of origin each bears an oval receptaculum seminis with two ducts. It is very important to observe that each oviduct is divided into three parts. All three parts are narrow except where swollen by the contained eggs. The first is very short and extends from the point of attachment to the ovary to about the level of the receptaculum; its wall is greatly folded and provided with little excrescences on the side opposite to the receptaculum. The middle and last portions of the oviduct are of about equal length. The middle portion is very thick-walled and apparently glandular. The last portion has very thin, transparent, membranous walls. At their hinder ends the oviducts unite in a thick-walled triangular sac, whose posterior angle is continued into the ovipositor.

I have found eggs in both the middle and last portions of the oviduct, but much more abundantly in the last. Their number varies greatly. In one specimen, for example, there were three eggs in each oviduct; in a second there were seven in one and six in the other; in a third there were eight in one and nine in the other.

The eggs at the time of laying show no appearance of embryos within them, but each consists of a quantity of milky fluid, containing numerous yolk granules, enclosed in a very thick, tough, but rather soft envelope of a pale yellow colour and beautifully sculptured on the outside. The sculpturing consists of little crumpled papillæ, somewhat resembling worm-casts, arranged at fairly regular intervals over the surface, and with much finer meandering ridges occupying the spaces between them. The eggs are oval in shape and measure about 1.9 by 1.5 mm.

A careful re-investigation of my material has led me to the following conclusions with regard to the egg-envelope. The envelope really consists of three membranes. (1) A very thin transparent membrane immediately surrounding the yolk and probably to be regarded as a vitelline membrane. (2) A very thick membrane which is apparently formed as a secretion in the thick-walled part of the oviduct. In sections of a female containing eggs in the oviduct this membrane is very clearly shown, and

is seen to have a thickness of about 0.036 mm. It is of a pale yellow colour when fresh, and has a very finely granular appearance. In a former paper I erroneously stated that this membrane or shell is smooth, or nearly so, while still *in utero*. It is true that the complete sculpture is not formed till the time of laying, but my recent observations have shown conclusively that the foundations of that sculpture are already present when the eggs are lying in the thin-walled part of the oviduct. These foundations consist of a number of little rounded protuberances regularly distributed over the surface of the thick membrane. They are not very obvious in fresh specimens and require careful looking for, but in specimens which have lain for a long time in alcohol previous to dissection the thick egg-membrane assumes a rather dark brown colour, and the protuberances may become conspicuous in surface view as much darker, well-defined circular areas about 0.04 mm. in diameter. In addition to these protuberances the thick membrane frequently, perhaps always, exhibits longitudinal striations of an ill-defined character. (3) The fortunate discovery of an egg partially extruded from the greatly distended ovipositor in a specimen preserved in alcohol indicates the formation of a thin, transparent membrane outside the thick one just described. This membrane appears to be formed as a secretion, probably by the walls of the triangular sac at the base of the ovipositor. The abnormal conditions in the case under notice have prevented its even deposition, and the amber-coloured, chitinous (?) material is mostly collected in a large plug attached to what was the inner end of the egg. I have little doubt that the wrinkling of this chitinous (?) membrane as it dries upon the already embossed under-lying membrane gives rise to the complete sculpture of the perfect egg-shell, for the smooth papillæ of the thick middle membrane exactly correspond in arrangement with the crumpled papillæ of the perfect shell.

The development of the embryo within the egg-shell appears to be a very lengthy business, for, as I have stated in a previous paper, one of the eggs laid in my vivarium in Melbourne hatched out after an interval of a year and five months from the time of

DESCRIPTION OF *PERIPATUS OVIPARUS*.

laying. The time of development may, however, have been prolonged by the exposure to artificial conditions. The eggs were laid between the middle of May and the end of July.

In the male the genital papilla is situated in the same position as in the female, but is much less prominent. On either side of it, in the angle between the leg and body, is a white papilla bearing the aperture of an accessory gland. Behind it and just in front of the anus are a pair of apertures belonging to other accessory glands. Crural glands occur in all the legs from the second to the thirteenth, and possibly also in the fourteenth. The aperture of the crural gland is situated on the under-surface of the leg, and the nephridial aperture lies inside it, except in the fourth and fifth legs. The white papilla which bears the aperture of the crural gland may be either prominent or sunk in a depression, according to the state of contraction, and hence the number of these white papillae on the under-surfaces of the legs may appear to vary in different specimens. I have been unable to find any crural glands in the female.

I have a number of males in my possession, and I assume that they belong to the same species because they were found in the same localities as the oviparous females, while no viviparous females with fifteen pairs of legs have yet been found in Victoria. The males exhibit the same range in pattern and colouration as the females.

It is unnecessary in this place to describe the general internal anatomy of *Peripatus oviparus*; suffice it to say that it conforms closely to the usual condition as described in other species.



NOTES ON THE SUB FAMILY *BRACHYSCELINÆ* WITH
DESCRIPTIONS OF NEW SPECIES.—PART IV.

BY WALTER W. FROGGATT.

(Plate XIX.)

Before describing several new species obtained during last year, I propose to rectify some errors in my previous papers on the gall-making coccids with regard to their classification.

In his last contribution to the study of the family *Coccidæ** Mr. Maskell, when dealing with the nomenclature of the sub-families, formed the sub-family *Idiococcinæ* for the reception of his genera *Sphaerococcus*, *Cylindrococcus*, and *Frenchia*. Many members of the above genera form regular galls, but others only waxy tests, while none of their galls are of the solid woody consistency of those of the Brachyscelid coccids; and the female coccids themselves differ structurally from the females of the latter. The Eucalyptus-gall coccids consisting of Schrader's three genera *Brachyscelis*, *Opisthoscelis*, and *Ascelis* coming into the sub-family *Brachyscelinæ* form another very natural group of the family *Coccidæ*.

When re-describing *Opisthoscelis subrotunda*, Sch., in my earlier paper†, I stated that the larva had tarsi terminating in two claws, which, as Mr. Maskell has pointed out, would remove them from the *Coccidæ* into the family *Psyllidæ*; what I mistook for the second claw, I find upon more careful examination to be the lower digitule, appendages like fine spines springing from the extremity of the tarsi.

* Maskell, Trans. N.Z. Inst. Vol. xxv. p. 236, 1892.

† Notes on the Family *Brachyscelidæ*, P.L.S. N.S.W. (2 Ser.) Vol. viii., p. 209, 1893).

BRACHYSCELIS DIPSACIFORMIS n.sp.

(Plate XIX., fig. 1.)

♀. Gall 6 lines high, $4\frac{1}{2}$ in diameter, generally oval but sometimes rounded at base, black to dark reddish brown in colour; produced upon the twigs of a slender-leaved eucalypt, sometimes solitary but chiefly in bunches of two or three; they grow out at the base like a small button, with the spines forming an erect mass on the upper surface, but as the gall matures it gradually forms a round solid centre with these spines turning downwards into a regular prickly covering, which reminds one of a small teasle. The walls of the galls are thin and solid; the chamber oval; the apical orifice small and circular, with the spines surrounding it often broken away or aborted into little woody bracts.

♀. Coccid dull yellow, short and stout, very hairy; the legs short with very small tarsal claws; dorsal side, the abdominal segments each bearing a row of very long slender spines, and thickly fringed with long hairs, increasing in density towards the tip where they form a regular brush; the anal appendages black, short, stout, and cylindrical, with a distinct median division and V-shaped cleft at the tips, which are slightly pointed. Upon the ventral side the hairs are of a pale golden yellow and much longer than the anal appendages. The coccid here described was dead and partially dried up when taken out of the gall.

♂. Gall and coccid unknown.

Hab. — North Queensland (Mr. F. M. Bailey).

I am indebted to my friend Mr. J. G. O. Tepper, of the Adelaide Museum, for the opportunity of describing this curious little gall, which he informs me was forwarded to him from Brisbane by the Government Botanist (Mr. F. M. Bailey), with the information that it came from North Queensland.

BRACHYSCELIS SESSILIS n.sp.

(Plate XIX., fig. 2.)

♀. Gall forming a rounded or oblong swelling on the branch, out of the centre of which springs up a tubular gall from 2 to 4 lines in height above the excrescence on the branch; 4 lines in diameter and perfectly flat on the truncated apex, with the exception of the small cone-shaped projection in the centre, encircling the minute apical orifice. The walls of the galls are stout and solid, containing a chamber rounded at the base and pointed towards the apex; each of these galls is distinct from the large swelling upon the branch from which they project, and can be detached without breaking.

♀. Coccid dull yellow, 4 lines in length, broad and round at apex, central lobe with two very small antennae and short fore-legs, the second pair rather large, with the hind pair largest, the first joint swollen and almost globular; the last thoracic segment broad, the first four abdominal ones regular, and tapering sharply to the tip, the anal segment, bearing the anal appendages, rounded. Dorsal view, head, and thoracic segments covered with very fine scattered tubercles, but bearing no regular spines; first abdominal segment with short irregular black spines along the apical margin, on the second segment increasing in numbers and regularity until on the last two forming a close regular ridge of stout black spines; anal appendages black, very short, broad at the base, conical and almost in contact at the base until near the apex, opening into a V-shaped angle; the whole coccid lightly covered with hairs, thickest towards the extremity of the abdomen.

♂. Gall and coccid unknown.

Hab.—Wallsend, near Newcastle. On a small rough-barked *Eucalyptus* sp.

BRACHYSCELIS THORNTONI, Froggt.

In my description of this species in a previous paper* I have confounded two very distinct species, a collection of fresh material which I collected last year at Wallsend having convinced me of my mistake. The former description will stand for the female gall in an immature state (also figured in the plate), but that of the male gall mass as there described must be withdrawn.

The male gall mass of this species is very variable in shape and size, often much curved and distorted, covered with warty excrescences and the edges broken and irregular, but the coccid tubes always coalesce and are not separated or distinct by themselves.

It is one of the most prolific species; I have seen some trees about Wallsend which are simply one mass of these galls; the more mature galls become more oval and lose the very pronounced ribs so conspicuous in the very young ones.

BRACHYSCELIS ROSÆFORMIS, n.sp.

(Plate XIX., fig. 3.)

♀. Gall 9 lines in length, not more than $1\frac{1}{2}$ lines in diameter at the base, gradually swelling out to three lines at the apex; brown to pale red; rather wrinkled on the surface; walls of the chamber thin, the chamber tubular, extending from the base to the tip; apical orifice small, circular, apex of gall truncate; sometimes the gall stands straight out from the leaf, but more frequently hangs downward along it.

♂. Gall forming a wrinkled irregular mass, growing from the side of the female gall close to the tip, swelling out into a rugose reddish brown mass, with the upper surface slightly concave, $1\frac{1}{2}$ inches across at the widest diameter and about a quarter

* P.L.S. N.S. W. (2 Ser.) Vol. vii., p. 371-72, 1892.

of an inch in thickness, containing over 1000 pale pink larval tubes, each of which is a distinct individual tube separated from any other at the tip.

Hab.—Wingham, Manning River (Mr. William Allan).

The specimen from which this is described was received with the note that it was not uncommon in that district. It consisted of single large Eucalyptus leaf carrying five female galls, surmounted with gall masses nearly as large as the one described, with several smaller ones, all of which sprang from the edge of the midrib of the leaf.

I have another variety of this gall obtained by the Rev. T. W. Alkin near Campbelltown, which is much more uniform in shape than the former; in this specimen there are six bright pink coloured galls springing from either side of the midrib of a very slender Eucalyptus leaf; the female gall is not more than half the length, the male gall mass much more funnel-shaped, containing on an average about 100 male tubes in each mass.

The gall described as the male of *B. Thorntoni* is another variety close to the Campbelltown one, of which I have had four specimens from around Wallsend.

EXPLANATION OF PLATE.

Brachyscelis dipsaciformis.

Fig. 1.—Female galls upon twig.

B. sessilis.

Fig. 2.—Female galls growing out of a branch.

B. rosæformis.

Fig. 3.—Female galls, each with its attached mass of male galls; towards the tip of the leaf are other immature galls.

ON A FIDDLER (*TRYGNORHINA FASCIATA*), WITH
ABNORMAL PECTORAL FINS.

BY JAS. P. HILL, DEMONSTRATOR OF BIOLOGY, IN THE
UNIVERSITY OF SYDNEY.

(Plate xx.)

Some little time ago there came into my possession through the kindness of Mr. J. Hastie, Broken Bay, N.S.W., a specimen of the Fiddler-ray (*Trygnorhina fasciata*), with markedly abnormal pectoral fins. The specimen presented so peculiar and striking an appearance that it was picked out by the fishermen when looking over the contents of their net after a haul and kept as a curiosity. On describing the specimen to my friend, Prof. G. B. Howes, he referred me to a note* by Dr. Traquair on an abnormal Thornback (*Raia clavata*). Dr. Traquair very kindly furnished me with a copy of his note, and I am now enabled to give a description of this specimen.

The Fiddler in question is a young male, measuring 26·9 cm. in length, and 11·2 cm. across the broadest part of the pectoral fins.

From the illustration accompanying this note it will be seen that the pectoral fins are markedly abnormal, and give the fish a very striking appearance. On each side the anterior portion of each pectoral fin is separated by a wide and deep notch from the head. The notch on the left side is, as in Dr. Traquair's Thornback, deeper than that on the right, causing the animal to have a very asymmetrical appearance. On the right side the notch extends backwards from the anterior end of the pectoral fin for a distance of 3 cm., and terminates almost on a level with the posterior border of the spiracular cleft. On the left side, however, the notch extends back for a distance of 4·5 cm., terminating at

* Note on an abnormally developed Thornback (*Raia clavata*), Ann. of Scottish Nat. Hist. Jan., 1892.

the point of articulation of the propterygium with the shoulder girdle. The entire anterior portion of the left fin, supported by the propterygium and its rays, is thus entirely free from the body. On both sides, and especially on the left, the propterygia are directed markedly outwards.

The only parallel for this condition among living Elasmobranchs appears to be found in the Angel-fish (*Rhina squatina*). In that form, as is well known, the anterior ends of the expanded pectoral fins extend forward as two short horns supported by the propterygia, and entirely free from the body wall. On the left side of our specimen, except for the greater forward extension of the fin, the condition in *Rhina* is essentially realised.

In the abnormal Thornback described by Dr. Traquair the anterior extremities of the pectoral fins projected as two short processes, one on either side of the snout. I have found a similar condition in one of a series of twelve young taken from a single female *Hypnos subnigrum*. In this specimen, which measured 6.1 cm. in length, the anterior ends of the pectoral fins projected as two blunt horns, one on the outer side of the anterior portion of each electric organ.

Similar cases of the non-adherence of the anterior extremities of the pectoral fins to the head have been recorded by Yarrell* for *Raia clavata*, by Day† for *R. clavata* and *R. batis*, and by Bureau‡ for *R. asterias*. All these cases are of the same nature, and of all recorded instances of this abnormality that of the *Trygonorhina* herein described is perhaps the most marked. The meaning of this variation, to which some slight importance may be attached from its occurrence in three distinct Batoid genera, is not far to seek. Prof. Howes, in his paper§ on the fin-skeleton

* Yarrell. British Fishes, ed. by Richardson, 1859, Vol. ii. p. 585 and p. 384.

† Day. British Fishes, Vol. ii. p. 345, Pl. CLXXI. fig. 2, and p. 337.

‡ Bureau. Bull. Soc. Zool. France, 1889, xiv. p. 313, and fig. (References from Bateson. Materials for the Study of Variation, p. 540.)

§ Observations on the Pectoral Fin-skeleton of Batoid Fishes. P.Z.S. 1890, p. 680.

of Batoids, says "that the Batoid type of fin has been derived from a shorter Selachoid one by forward rotation and general enlargement is sufficiently clear from known facts of development.' It is in these facts, viz., that the pectoral fin of Batoids undergoes a forward growth in the embryo and only secondarily fuses with the cephalic integument, that these cases of non-adherence in the young or adult find their explanation. This is fully borne out by the examination of a uterine embryo of *Urolophus testaceus*, 3 cm. in length, in the teaching collection of the Biological Department of this University. In this embryo in which distinct external gills are present and the cranial flexure is well marked, the broadly expanded pectoral fins extend forward beyond the mouth as two blunt processes separated by a cleft from the head, and are at this stage comparable with the adult condition of the pectoral fins in *Rhina*.

From these facts of development we are led to regard the non-adherence of the anterior portions of the pectoral fins in *Trygonorhina* and the incomplete adherence of the anterior ends of the fins in the other recorded cases as retentions more or less complete of an embryonic or ancestral condition—as reversions in fact, for if there is any truth at all in the law of recapitulation there can be little doubt but that the free condition of the anterior portion of the pectoral fin of Batoids was the primitive one. It is interesting in view of this to find this feature of non-adherence most marked in the Rhinobatid genus *Trygonorhina*, the Rhinobatids being in many points transitional between the *Batoidei* and *Selachoides*.

In conclusion I have to express my indebtedness to Mr. Robert Grant for the photograph from which the accompanying drawing was made.

EXPLANATION OF PLATE.

Dorsal aspect of an abnormal specimen of *Trygonorhina fasciata*—reduced about $2\frac{1}{2}$ times.

NOTES AND EXHIBITS.

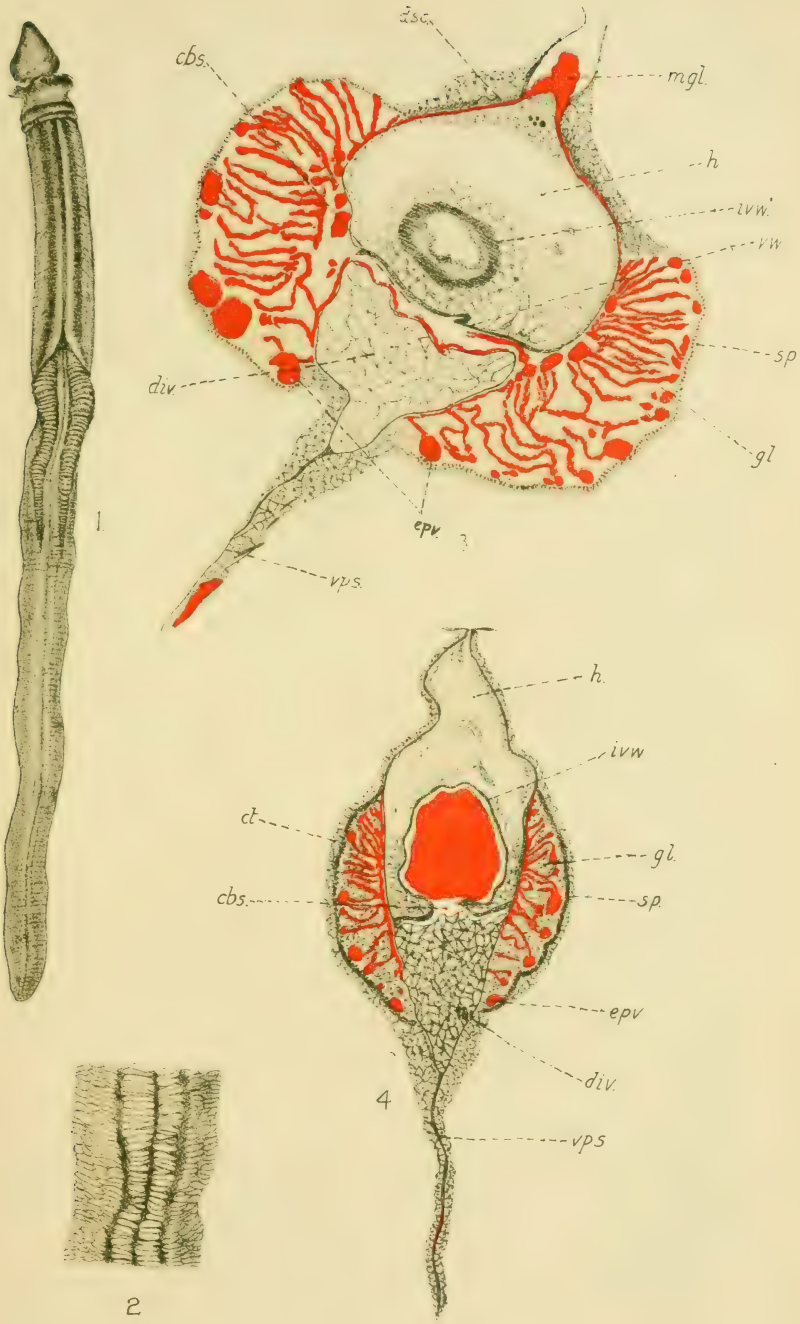
Mr. Froggatt exhibited specimens of the galls mentioned in his paper, together with drawings of the same. Also two hazel hoops taken from powder kegs on board one of the powder hulks in Sydney attacked by the larvæ of *Gracilia pygmaea*, Fabr., a small European longicorn beetle, specimens of which were shown, and which had been evidently introduced in the wood. The larvæ burrow under the bark of the hoops. As many as over 40 specimens were bred from two hoops. Also the remains of a larva of the Australian silk worm moth (*Antheraea eucalypti*) destroyed by parasitic hymenoptera (Fam. *Braconidae*) which had produced a remarkable mass of white cotton-like substance $2\frac{1}{2}$ inches long and $1\frac{1}{2}$ inch in width, enveloping a double row of cocoons.

Mr. Maiden sent for exhibition some specimens of fire-sticks used by the natives on the ranges behind Cardwell, N. Queensland. They are tied up in bundles with a board on which the sticks are rubbed, painted and carved to represent some animal. Also some pearl-shell fishhooks cut into slender curved points, with modernised editions made from iron nails picked up on the sea shore in which the old form is reproduced, used by the natives of Hinchinbrook Island. Also a shell forehead ornament from the same place.

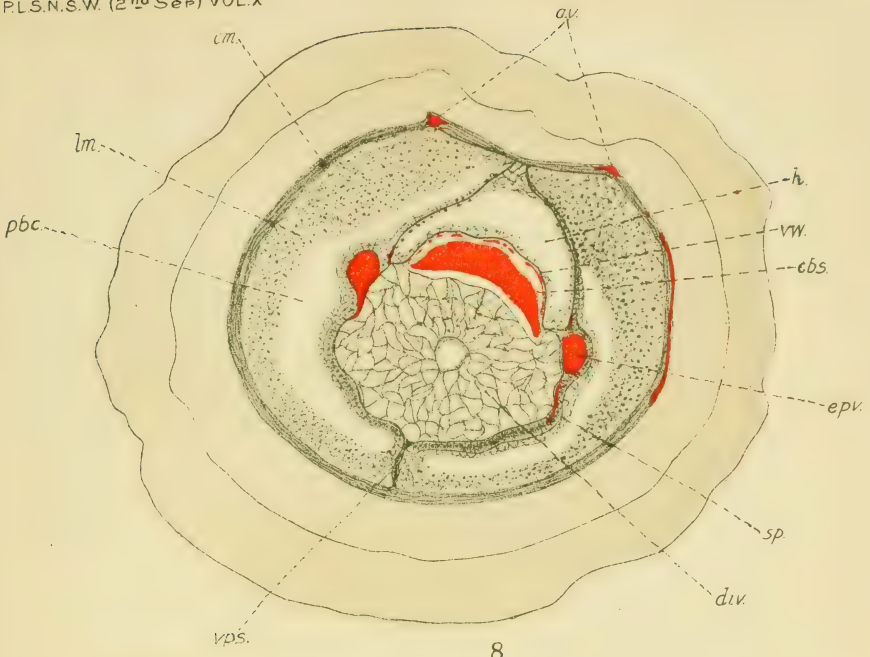
Mr. Garland showed a miscellaneous gathering of fragments from an aboriginal kitchen midden in a cave shelter at Pittwater, comprising spines of various fishes, bones of marsupials, &c., together with a pointed bone, probably in use as a piercer in sewing skins.

Mr. Brazier exhibited a varied collection of zoological and botanical specimens found by F. C. Brazier at Nelson Bay Beach (Bronte), Waverley, during the southerly gales of April 11-13th last, comprising *Sepia apama*, Gray, common; *S. elongata*, Orb., rare, one imperfect specimen; *S. capensis*, Orb., thirty specimens; *S. australis*, Orb., eight specimens in very fair condition; *Ianthina*

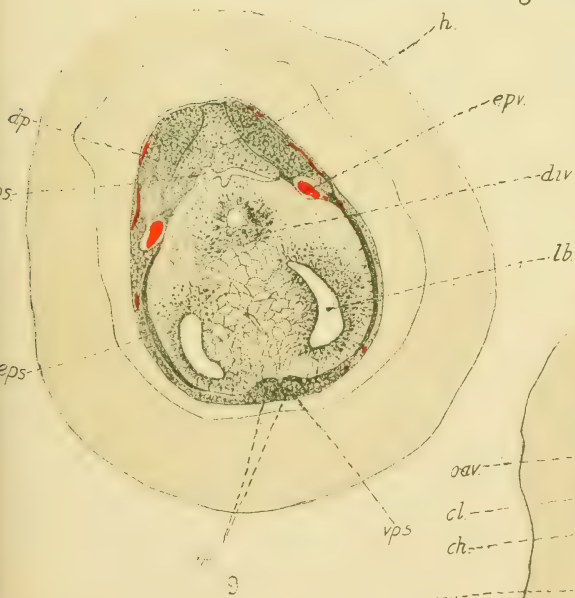
caerulata, Reeve, two hundred living specimens; *I. fragilis*, Lam., eight living specimens; *Spirula Peroni*, Lam., five imperfect specimens, with portion of the animal attached to the shells; *Lepas Hilli*, Leach, on *Sepia apama*, Gray, on slag from furnace fires, and a large nut from Pacific Islands; *L. pectinata*, Spengler, on *Spirula Peroni*, *Sepia capensis*, *Ianthina caerulata*, on corks, pieces of packing cases, and slag from furnace fires; three species of fishes; two species of crabs; numerous specimens of candle nuts *Aleurites trilobata*; and the fruit probably of *Barringtonia speciosa*.



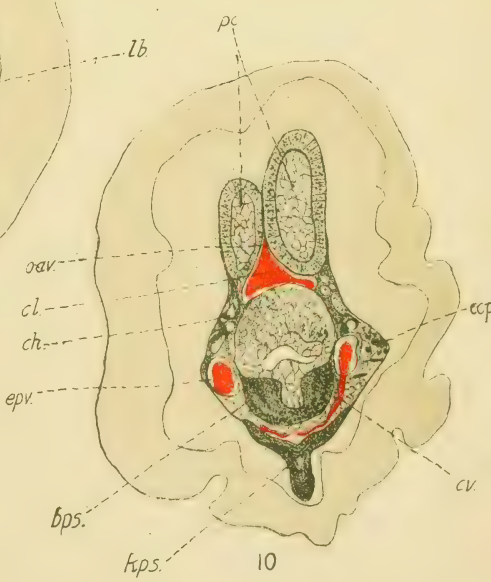




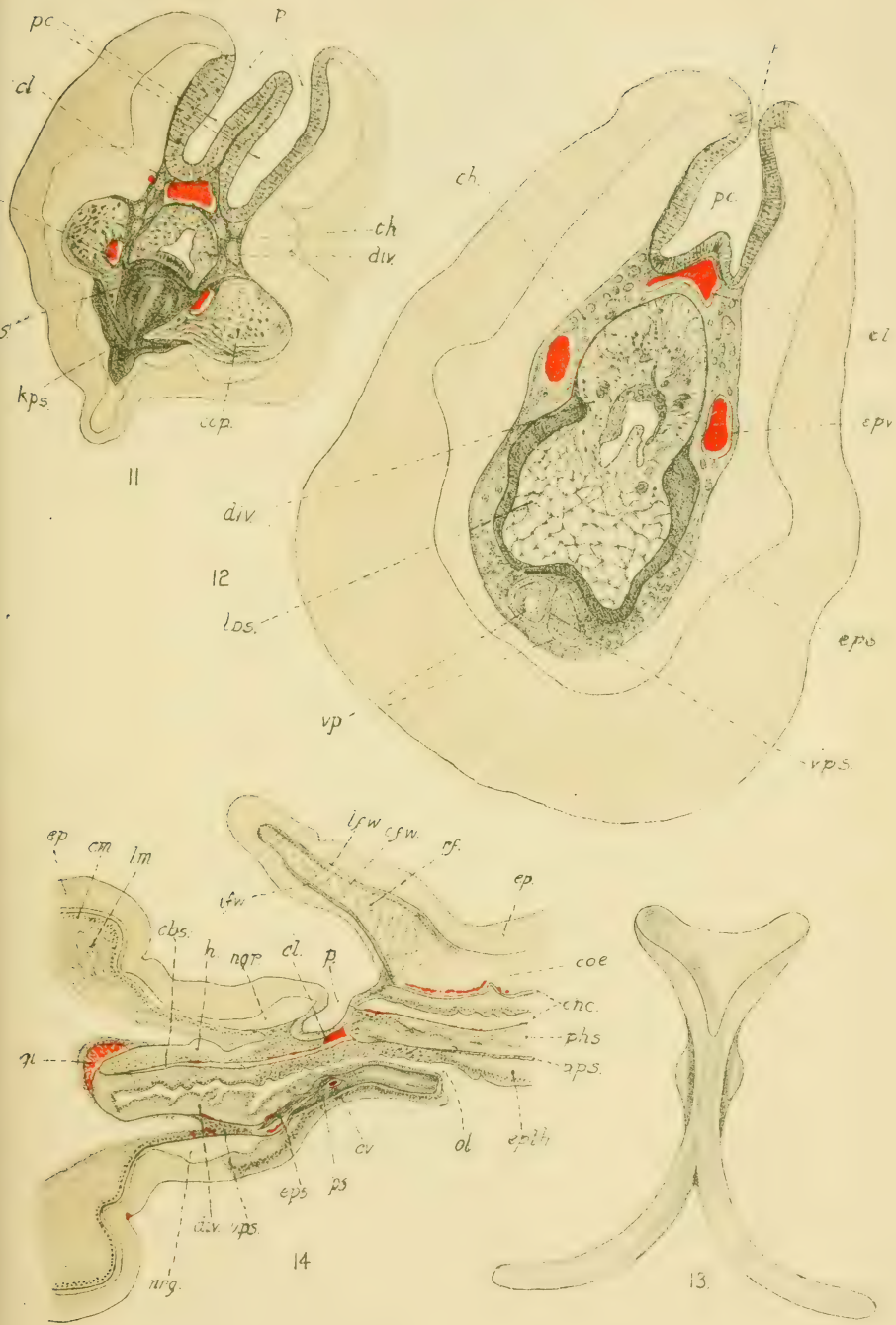
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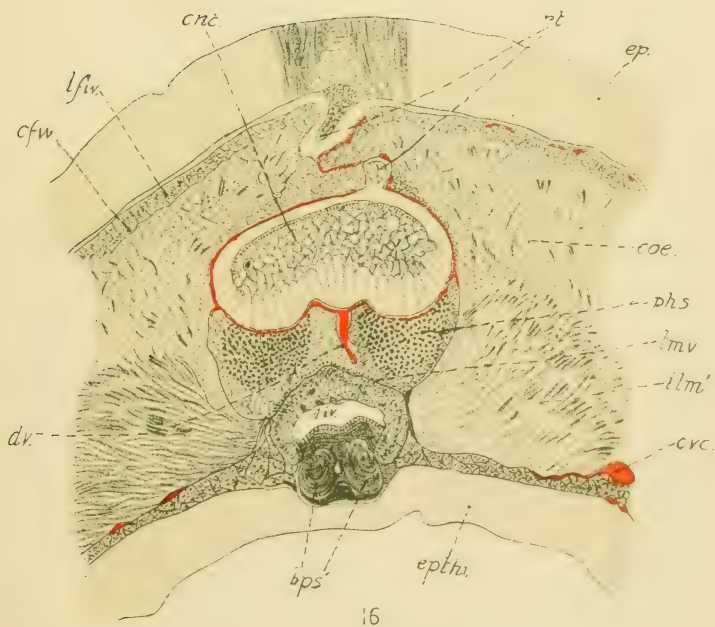
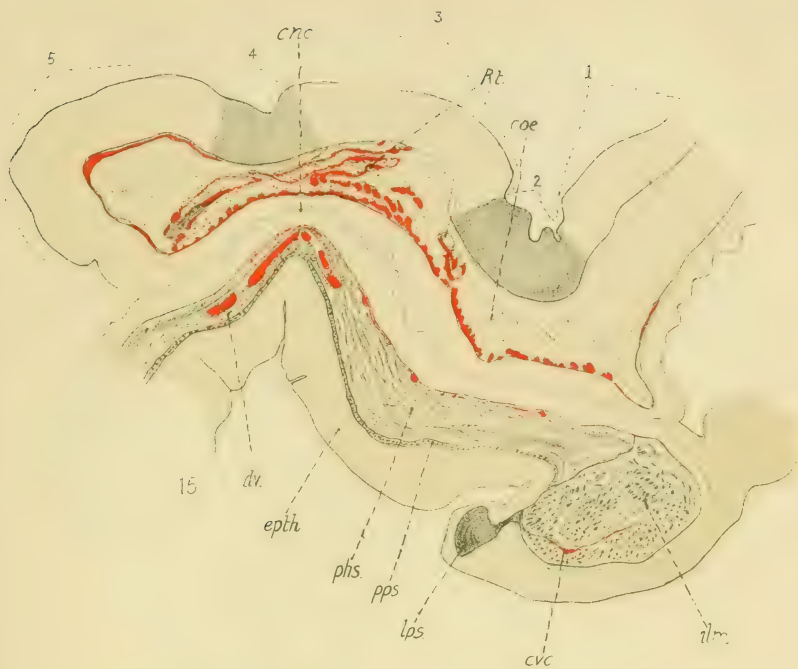


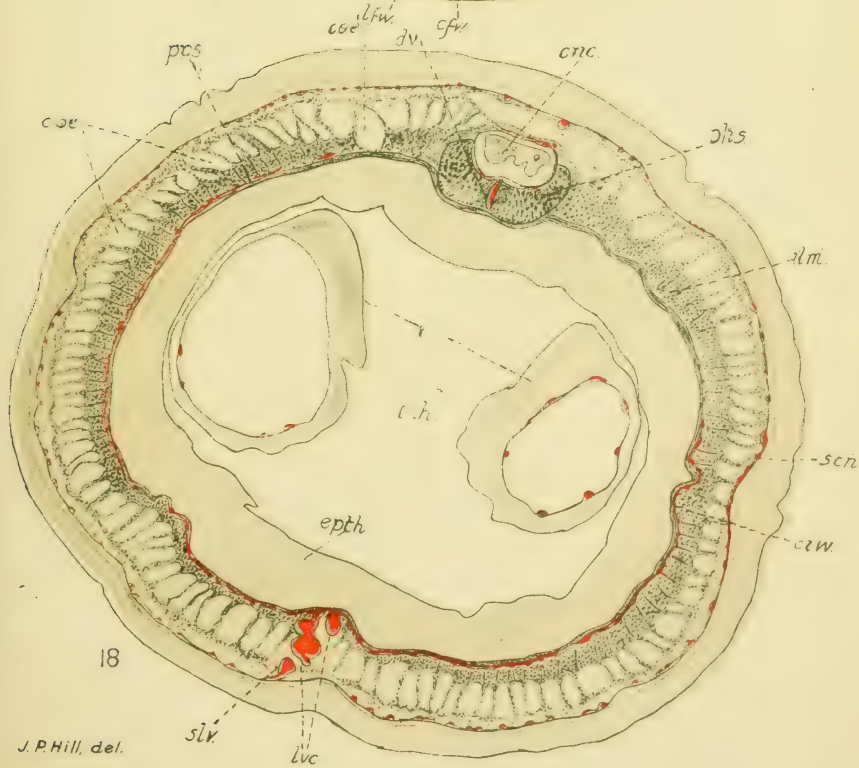
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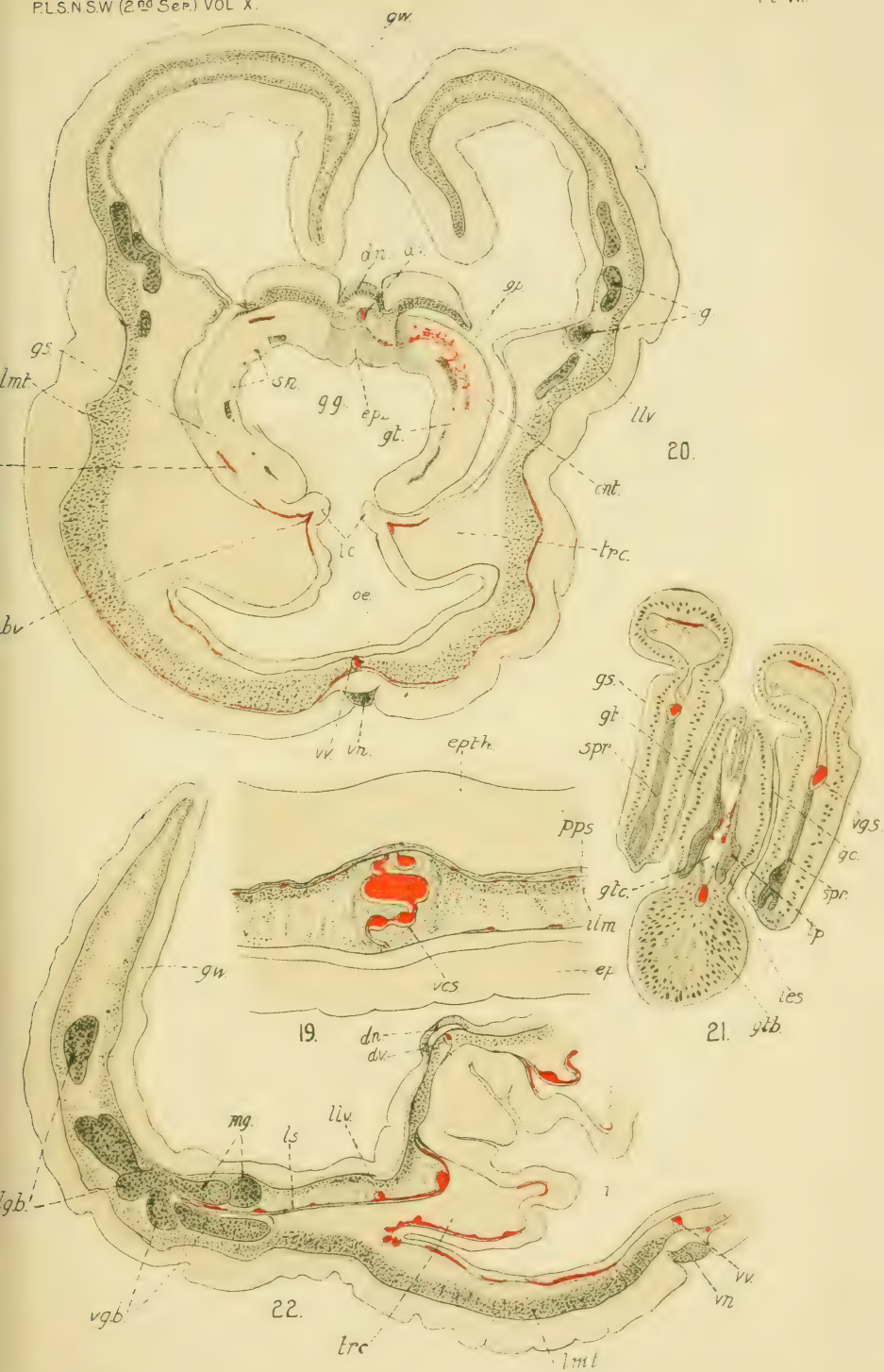


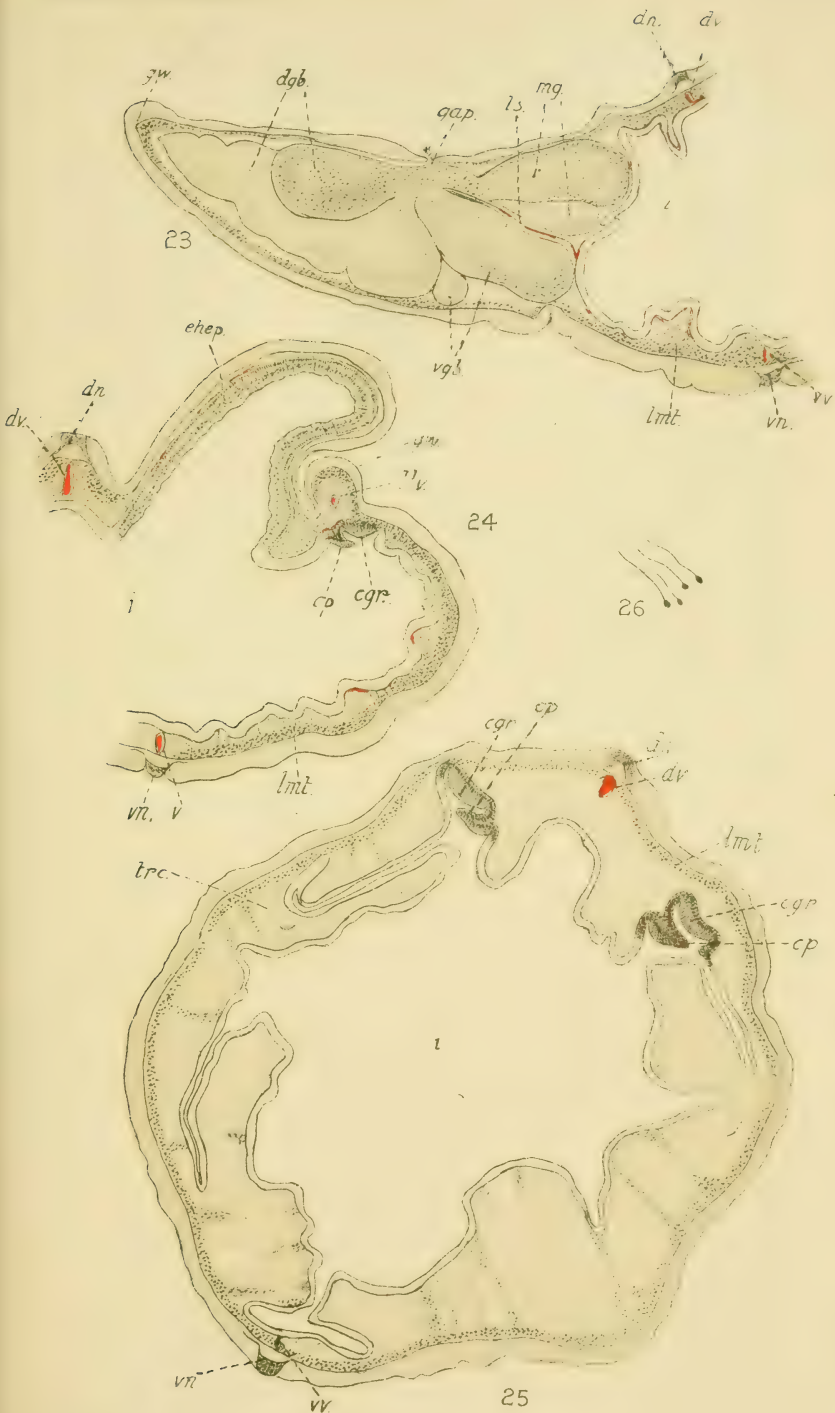
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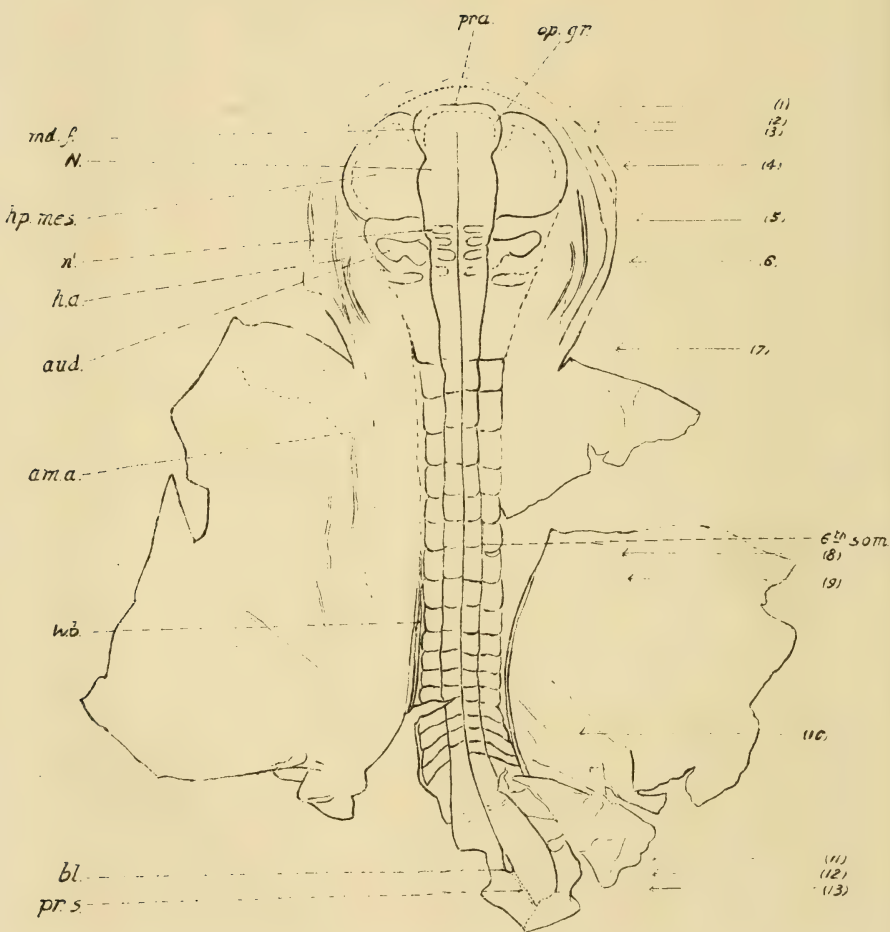


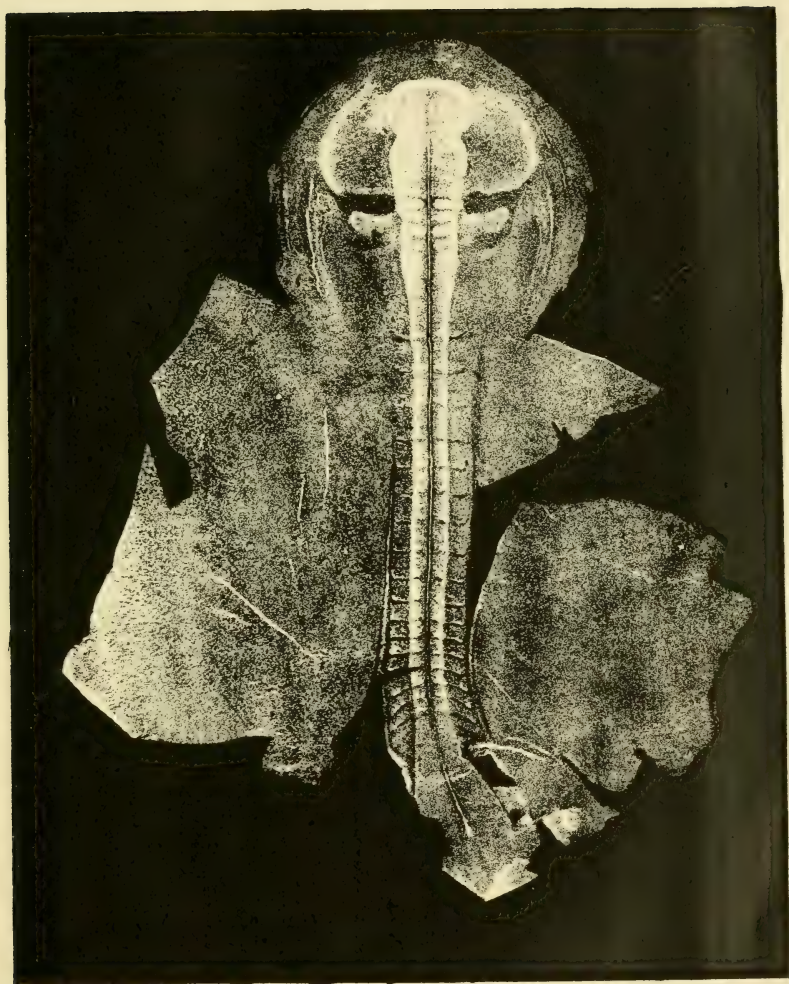












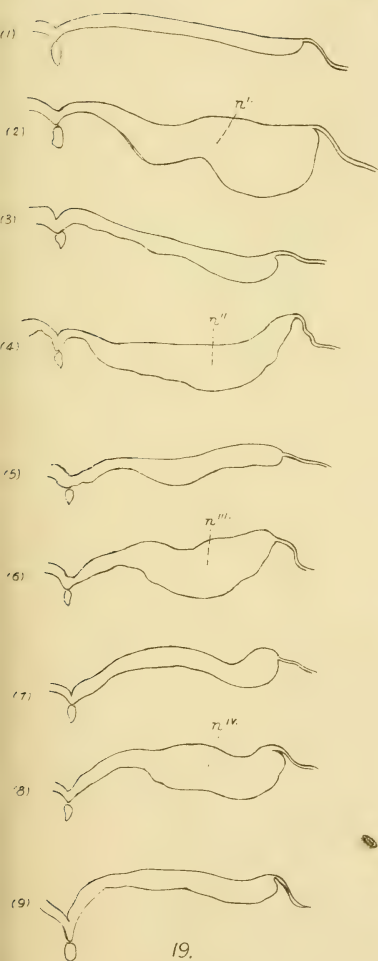
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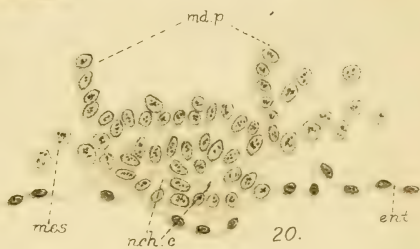
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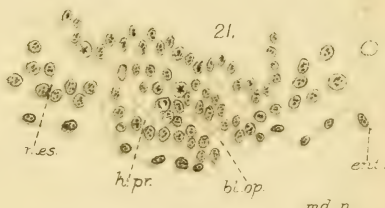
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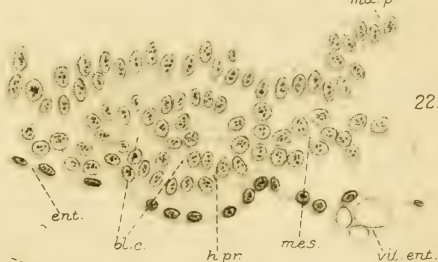
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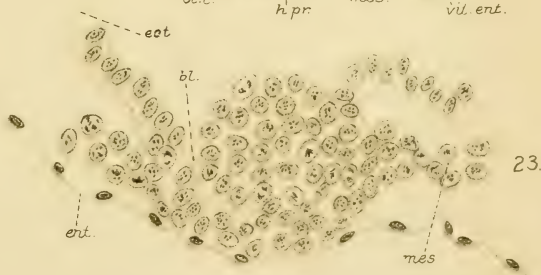
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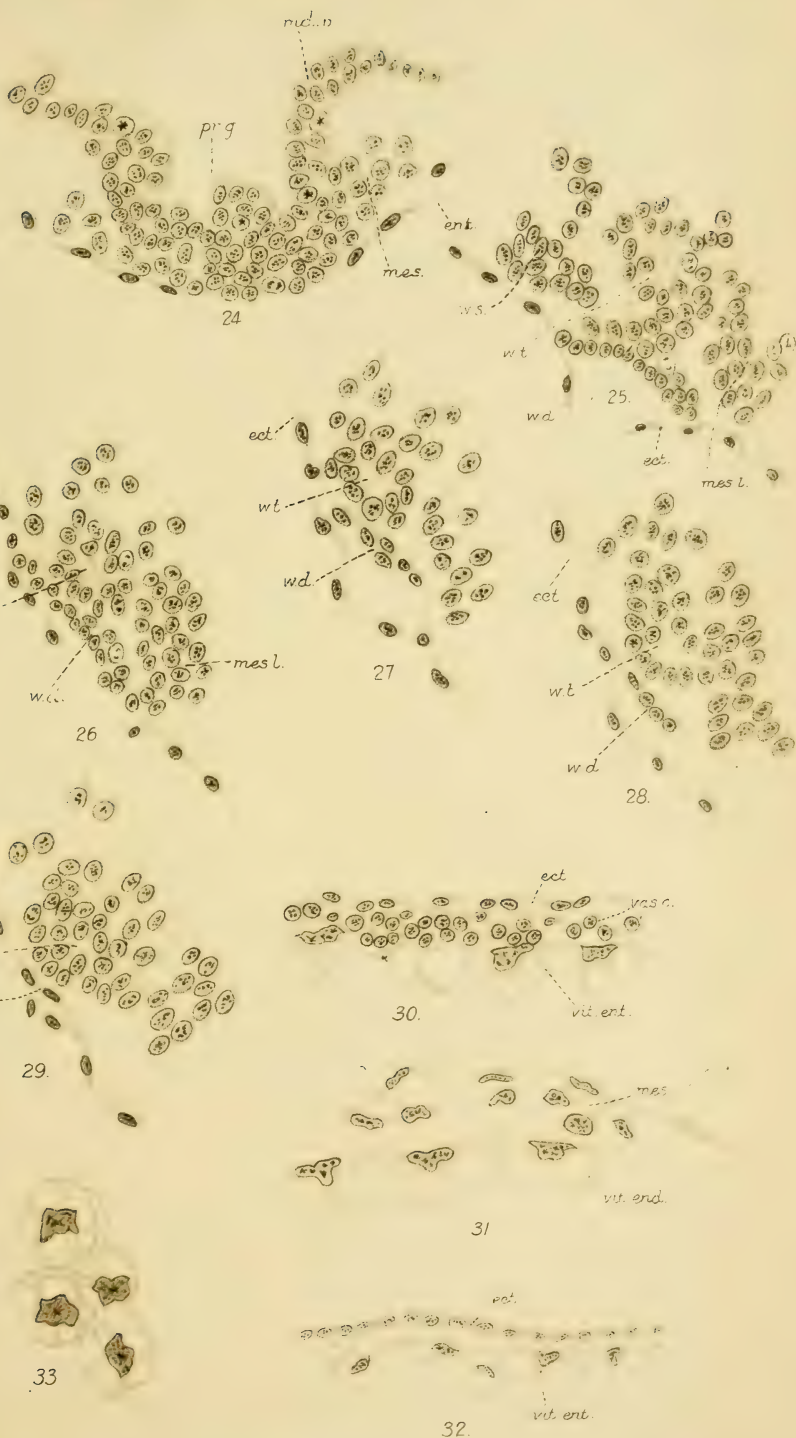
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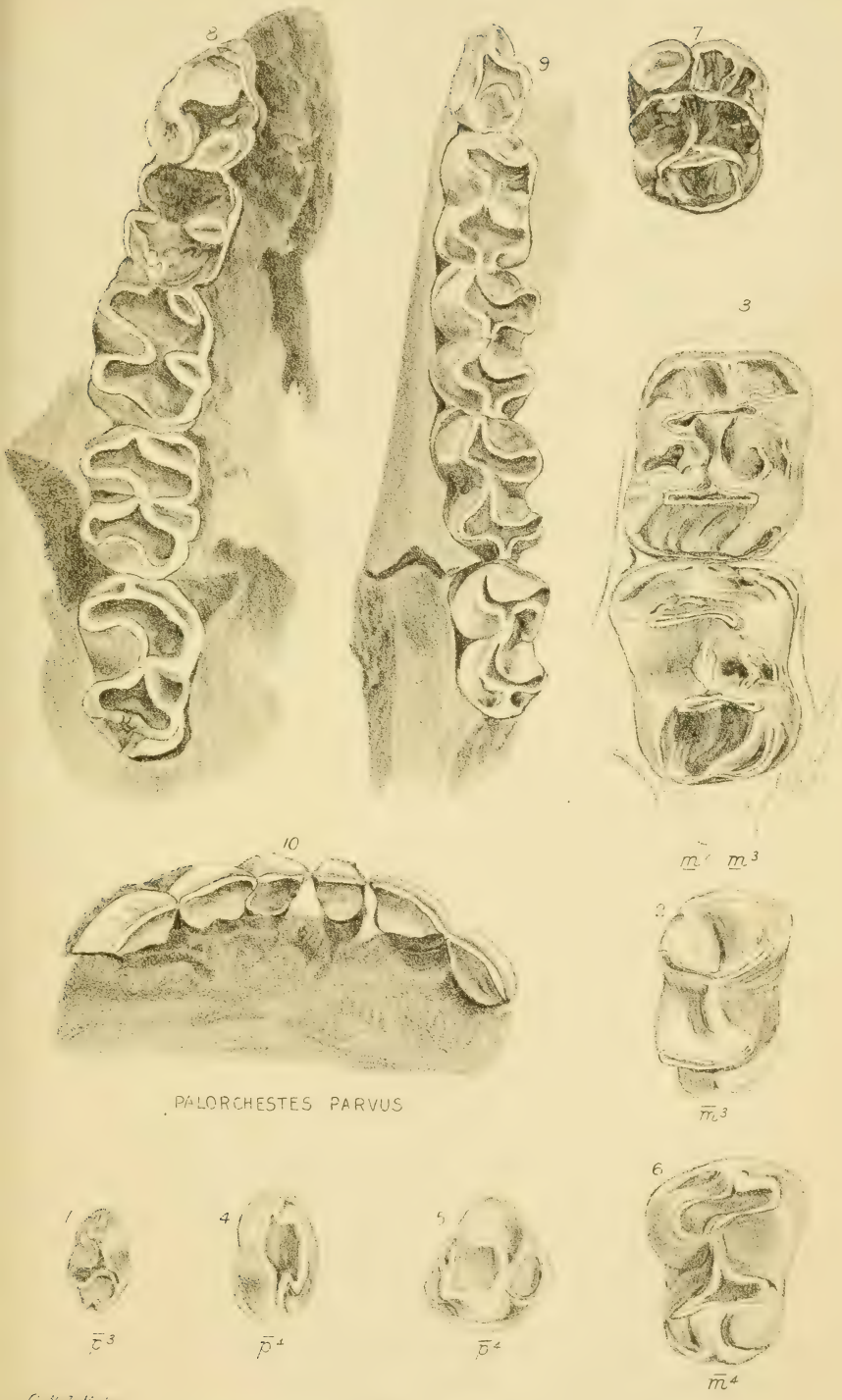


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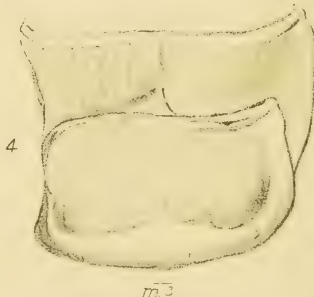
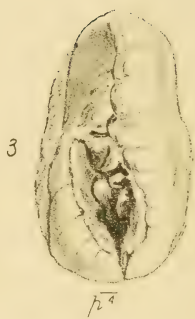
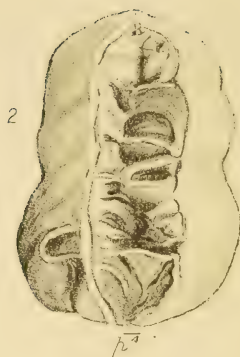
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PALORCHESTES AZAEL, OW.

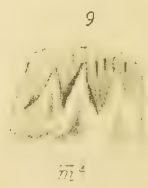
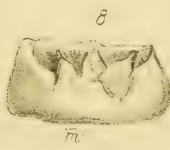
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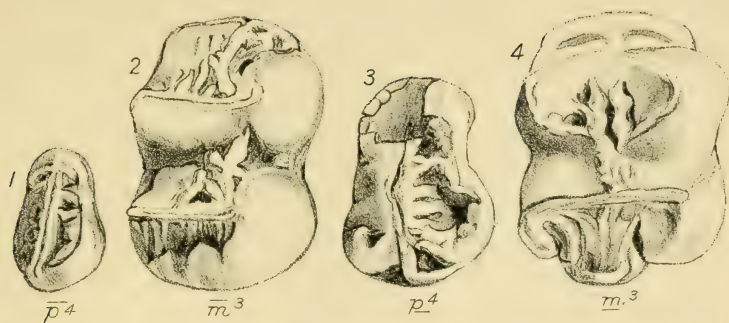
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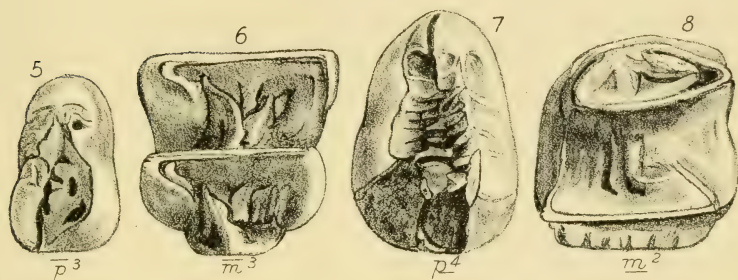
STHENURUS PALES - x 2



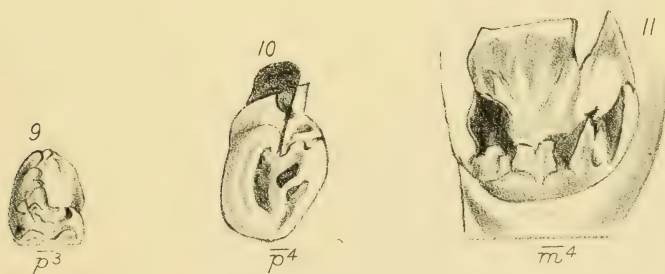
STHENURUS GOLIAH, OW.



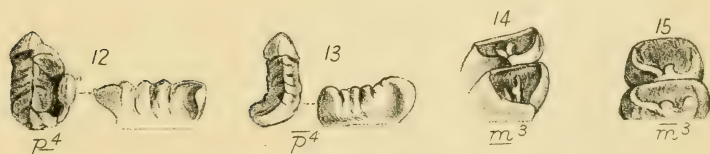
Sthenurus otuel, Ow. x2



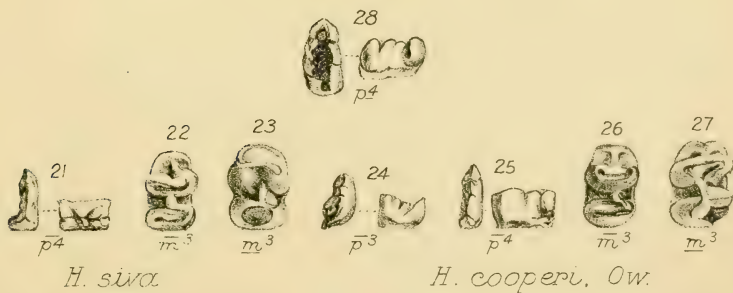
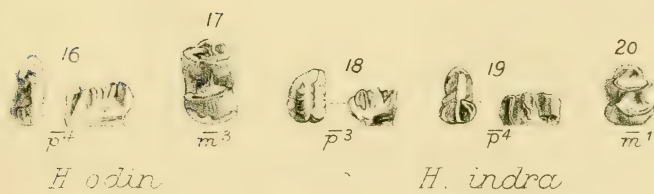
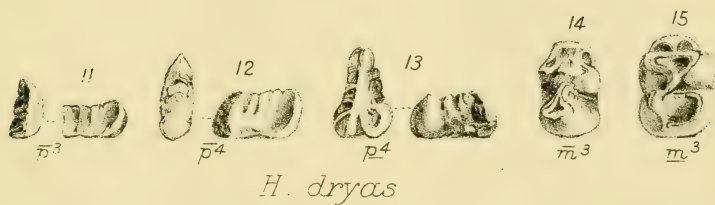
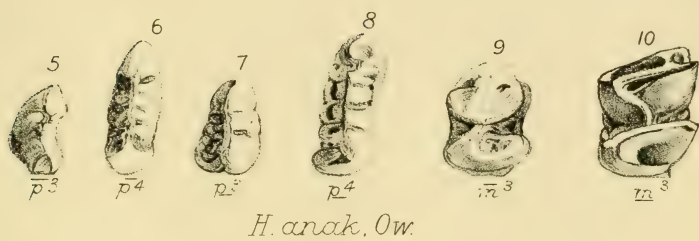
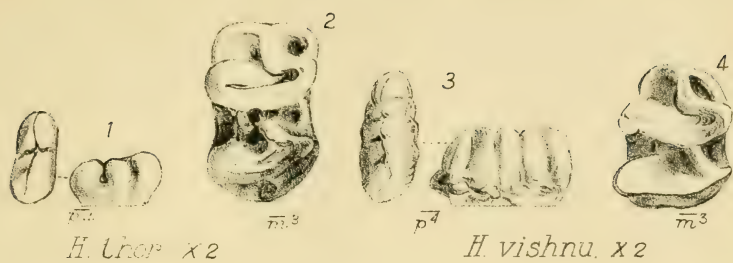
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Sthenurus atlas x2



Halmalurus vinceus

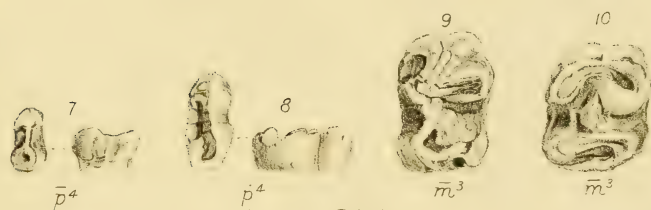




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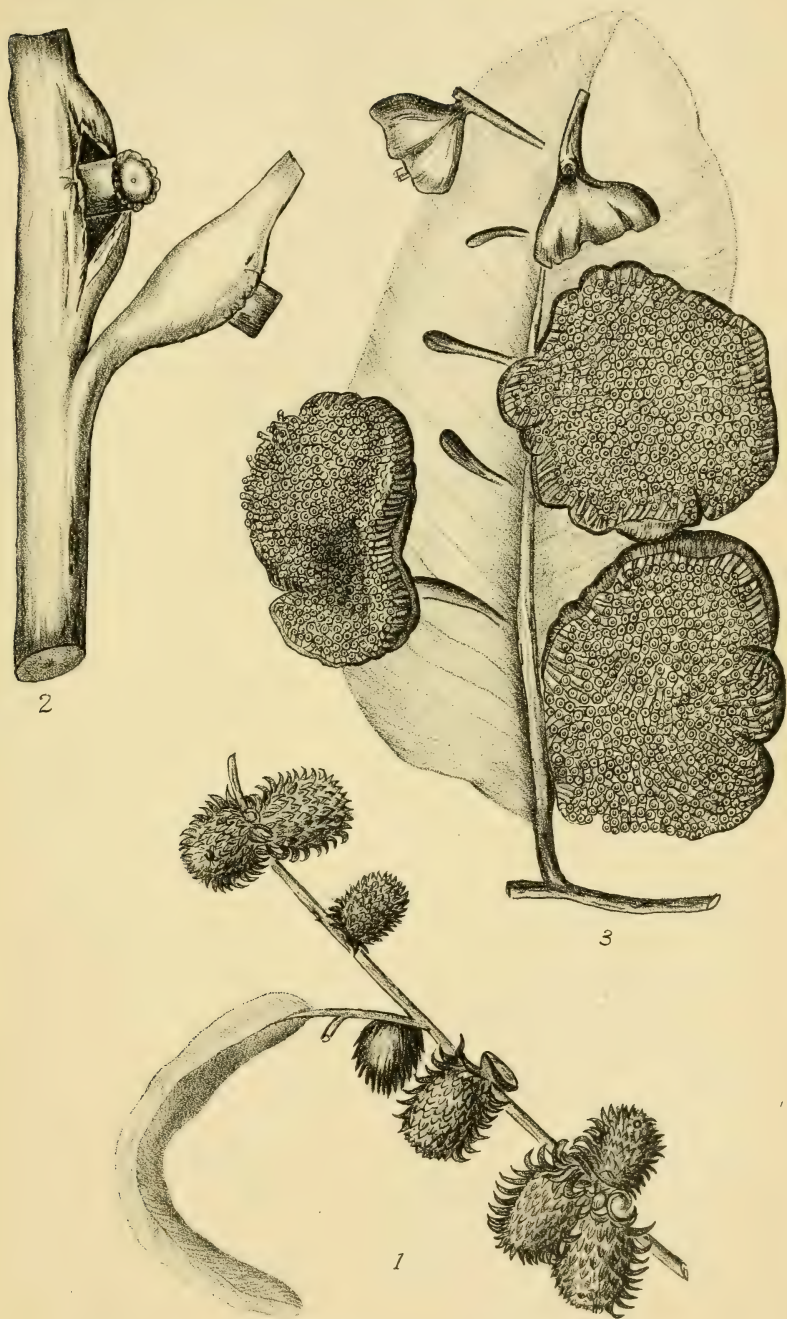
MACROPUS FAUNUS



M. PAN.



M. MAGISTER



W.W.F. del.

Brachyscelid Galis.



Trygonorhina Fasciata, M. & H.



WEDNESDAY, MAY 29TH, 1895.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, August 28th, 1895.

Mr. P. N. Trebeck, J.P., in the Chair.

Mr. John MacPherson, M.A., Sydney University, and Dr. R. Broom, B.Sc., Taralga, N.S.W., were elected Members of the Society.

DONATIONS.

Geological Survey of India—Records. Vol. xxviii. (1895), Part 1. *From the Director.*

Zoological Society of London—Abstract. 5th March and 2nd April, 1895: Transactions. Vol. xiii. Part 10: Proceedings, 1894, Part iv. *From the Society.*

Madras Government Museum—Bulletin. No. 3. Second Edition, revised. *From the Superintendent.*

Perak Government Gazette. Vol. viii. (1895), Nos. 7-10. *From the Government Secretary.*

K.K. Zoologisch-botanische Gesellschaft in Wien—Verhandlungen. xlv. Bd. (1895), 2-3 Hefte. *From the Society.*

Indian Museum—Natural History Notes. Series ii. No. 18.
From the Superintendent.

Australasian Journal of Pharmacy. Vol. x. Nos. 112-113
(April-May, 1895). *From the Editor.*

Agricultural Gazette of N.S.W. Index to Vol. v. (1894); Vol.
vi. (1895), Parts 3-4. *From the Hon. the Minister for Mines and
Agriculture.*

American Museum of Natural History—Bulletin. Vol. vii.
(1895), Sig. 3-4 (pp. 33-64). *From the Museum.*

Johns Hopkins University Circulars. Vol. xiv. Nos. 115, 117
and 118 (Nov., 1894, March and April, 1895). *From the
University.*

American Geographical Society—Bulletin. Vol xxvi. (1894),
No. 4, Part 2; Vol. xxvii. (1895), No. 1. *From the Society.*

Société Scientifique du Chili—Actes. Tome iv. (1894), 4^{me} Liv.
From the Society.

Canadian Institute—Canadian Journal. First Series. Vols.
ii.-iii. (1853-55); Second Series. Vols. i.-ix. and xii.-xiv. (1856-75);
Third Series (Proceedings). Vol. i. Fasc. 2-5; Vol. ii. Fasc. 3;
Vol. iii. Fasc. 2-3 (1885-86). *From the Institute.*

Société Royale Linnéenne de Bruxelles—Bulletin. xx^{me}.
Année (1895), Nos. 4-6. *From the Society.*

Société Impériale Mineralogique de Russie—Verhandlungen.
xxxi. Bd. (1894). *From the Society.*

Société Hollandaise des Sciences à Harlem—Archives Néer-
landaises. Tome xxviii. 5^{me} Liv. (1895). *From the Society.*

Pharmaceutical Journal of Australasia. Vol. viii. No. 4
(April, 1895). *From the Editor.*

Société d'Horticulture du Doubs, Besançon — Bulletin. n.s.
No. 51 (March, 1895). *From the Society.*

Zoologischer Anzeiger. xviii. Jahrg. Nos. 471-473 (March-April, 1895). *From the Editor.*

Australian Orchids. By R. D. Fitzgerald, F.L.S. Vol. ii. Parts 3-5 (1888-94). *From the Government Printer.*

American Naturalist. Vol. xxix. No. 340 (April, 1895). *From the Society.*

U.S. Department of Agriculture—Division of Entomology—Insect Life. Vol. vii. No. 4 (1895). *From the Secretary of Agriculture.*

Hooker's Icones Plantarum. Vol. iv. Fourth Series. Part 3 (April, 1895). *From the Director, Royal Gardens, Kew.*

Department of Mines and Agriculture, Sydney—Records of the Geological Survey of N.S. Wales. Vol. iv. Part 3 (1895). *From the Hon. the Minister for Mines and Agriculture.*

Victorian Naturalist. Vol. xii. No. 1 (April, 1895). *From the Field Naturalists' Club of Victoria.*

Société Belge de Microscopie—Annales. Tome xix. 1^{er} Fasc (1895). *From the Society.*

Cambridge Philosophical Society—Proceedings. Vol. viii. Part iv. (1895). *From the Society.*

Zoologische Station zu Neapel—Mittheilungen. xi. Bd. 4 Heft (1895). *From the Director.*

Oxford University Museum—Catalogue of Books added to the Radcliffe Library during the Year 1894. *From the Radcliffe Trustees.*

Muséum d' Histoire Naturelle, Paris—Bulletin. Année 1895. Nos. 1-2. *From the Museum.*

Société Impériale des Naturalistes de Moscou—Bulletin. Année 1894. No. 4. *From the Society.*

Naturwissenschaftlicher Verein für den Reg.-Bez. Frankfurt a. O.—Helios. xii. Jahrg. (1894), Nos. 7-12; Societatum Litterae. viii. Jahrg. (1894), Nos. 10-12; ix. Jahrg. (1895), Nos. 1-3. *From the Society.*

Académie Impériale des Sciences de St. Pétersbourg—Bulletin, v^e Série. Tome ii. No. 2 (1895). *From the Academy.*

Free Public Library, Sydney—Report from Trustees for 1894. *From the Trustees.*

Naturhistoriske Forening i Kjöbenhavn—Videnskabelige Meddelelser for Aaret 1894. *From the Society.*

OOLOGICAL NOTES.

BY ALFRED J. NORTH, F.L.S., AUSTRALIAN MUSEUM, SYDNEY.

With the exception of an immature egg of *Eudynamis cyanocephala* previously described by me,* the eggs of the following species are now, so far as I am aware, described for the first time.

EUDYNAMIS CYANOCEPHALA, Latham.

Flinder's Cuckoo is freely distributed during the spring and summer months throughout the coastal scrubs of Eastern Australia, its range also extending around the northern and extreme north-western portions of the continent and to New Guinea and Timor. In New South Wales it generally arrives during the latter part of September, and is more frequently met with in the tropical and luxuriant brushes of the northern coastal rivers; localities where the wild fig, native cherry and numerous other fruit and berry-bearing trees and shrubs abound, and which afford this species an abundant supply of food. It does not confine its diet entirely to wild fruits and berries, for in the high table-lands of the New England District it freely enters gardens and orchards in search of food, committing great depredations among cultivated fruits, especially plums and cherries. About the end of February it retires northwards again. Hitherto the only egg of this parasitic Cuckoo I had ever seen was an immature one obtained by Mr. George Masters at Gayndah, Queensland, on the 25th of November, 1870. Having shot at a female and broken her wing, while pursuing her on the ground the egg was dropped. For an opportunity of examining a normal egg of this Cuckoo I am indebted to Mr. S. W. Jackson, who recently watched and waited while one of these parasites deposited her egg in the

* Proc. Linn. Soc. N.S.W. Vol. ii. 2nd Series, p. 544 (1887).

deep cup-shaped nest of the Green-backed Oriole (*Mimeta viridis*), one of the most notorious orchard marauders in New South Wales. From Mr. Jackson's letter accompanying this egg, I have extracted the following information :—

“While collecting on the 31st of October, 1894, in a scrub near South Grafton I heard the loud and peculiar “coo-ee” of Flinder's Cuckoo, and upon approaching a large “Box-tree” (*Eucalyptus robusta*), I observed in it a pair of *Eudynamis cyanocephala*, the female being perched close to a nest of *Mimeta viridis*. Thinking perhaps that the Cuckoo had laid in it, I climbed the tree, and found that the nest contained three fresh eggs of the Oriole; these I left and descended to the ground. The female Cuckoo, which I had frightened away when starting to climb the tree, now returned, and calling to her mate both sat near the nest. After watching them for a few minutes the male flew away, and to my joy the female took possession of the Oriole's nest. I did not leave the spot, but sat down in the shade of the Eucalyptus, and after waiting about half-an-hour got up and suddenly clapped my hands, but she would not leave the nest. I started again to climb the tree, when off she flew and never returned. Upon reaching the nest, and making a further examination of its contents, I was greatly delighted to find that in addition to the three eggs of the Oriole it now contained the previously unknown egg of Flinder's Cuckoo. During the time the Cuckoo had possession of the Oriole's nest both the male and the female of the latter sat in the tree, but did not interfere with the occupant of the nest.”

The egg of *Eudynamis cyanocephala* is oval in form and of a pale reddish-salmon ground colour, minutely dotted and spotted with different shades of reddish and purplish-brown, the latter colour predominating and appearing as if beneath the surface of the shell; the smaller end of the egg is more sparingly marked, but towards its thicker axis are a few small blotches of umber brown. There are many indistinct underlying blotches and smears of dull purplish-brown, of which the largest is a longitudinal marking measuring 1·1 inch in length by 0·4 inch in

breadth. The egg measures 1.36 inch in length by 1.02 inch in breadth, and without its underlying blotches and smears somewhat resembles those of the Friar Bird (*Tropidorhynchus corniculatus*).

The Oriole's eggs from the above nest are of the usual variety found, being of a creamy-brown ground colour, minutely dotted and boldly blotched all over with different shades of umber-brown, intermingled with underlying markings of deep bluish-grey. Length, (A) 1.35 × 0.98 inch; (B) 1.4 × 1.03 inch; (C) 1.43 × 1.01 inch.

It will be observed that the egg of Flinder's Cuckoo is the same size as those of *Mimeta viridis*, although as a rule the eggs of Australian Cuckoos are larger than those of the birds in whose nests they are deposited. In the choice of a foster-parent for its young *Eudynamis cyanocephala* has, however, exercised great discrimination in selecting a species that, like itself, depends entirely on fruits and berries for its subsistence during the spring and summer months.

MEGALURUS GALACTOTES, Temminck.

Although the range of the Tawny Grass-bird extends over the greater portion of Northern and Eastern Queensland, and Northern New South Wales, it is of so shy and retiring disposition that it is a species seldom met with, and only on one occasion have I heard of its nest and eggs being found. The late Mr. George Barnard, of Coomoooolaroo, Queensland, shortly before his decease informed me that while collecting specimens of Microlepidoptera on his station on the 26th of October, 1893, he flushed one of these birds from the rush-bordered bank of a dry creek, and, after a diligent search, succeeded in finding its nest at the bottom of a tuft of long rushes. The nest was a deep cup-shaped structure, slightly domed or narrowed at the top, and was outwardly composed of dried swamp grasses, lined inside with feathers, and contained three fresh eggs, two of which he unfortunately broke. The remaining egg has recently been forwarded to me for examination by Mr. Charles Barnard. It is precisely

similar in colour and markings to those of its southern congener *M. gramineus*, but is slightly larger, being of a reddish-white ground colour, freckled all over with purplish-red markings, which predominate as usual on the thicker end of the egg. Length, 0.8 × 0.58 inch.

PLATALEA MELANORHYNCHA, Reichenbach.

The Black-faced Spoonbill is generally distributed in favourable situations over the north-eastern and northern portions of the Australian Continent, its range extending also to the Aru Islands, where several examples were procured by the late Mr. S. White, and which are now contained in the Reference Collection of the Australian Museum. In New South Wales it is a comparatively rare species, and is seldom met with except on the mangrove flats and swamps adjacent to the northern coastal rivers, but recently it has been found breeding on an inland swamp near the extreme southern boundary of the colony. For an opportunity of examining and describing the eggs of this species I am indebted to Mr. James Kershaw, of the National Museum, Melbourne, who has kindly forwarded me a set, together with the following note:—“The eggs of *Platalea melanorhyncha* I sent you last week were obtained by Mr. H. G. Evered, who has supplied me with the following information relative to the taking of them:—‘While duck shooting on Christmas Day, 1893, on one of the swamps along the banks of the Murray River, about sixty miles above Echuca, and when nearing an Ibis rookery, the man who was poling the boat drew my attention to a bird flying with the White Ibis (*Threskiornis strictipennis*) which we had disturbed; at the same time informing me that the bird was almost a stranger in those parts, and that he had not seen a specimen for the previous four or five years. As it would not leave the spot, but continued flying in a circle, we thought there might possibly be a nest near at hand, so we concealed our boat in a bed of reeds and watched. After a little while all the Ibis, and lastly the bird which I now recognised to be a Spoonbill, settled in an adjacent bed of reeds. We now approached as noiselessly as possible, and when within

about forty yards it again rose with the Ibis, and I was successful in shooting it. Upon examining the place, we found the nest of the Spoonbill built amongst those of the White Ibis; it was an open flat structure, composed of broken down reeds and twigs, measuring two feet across, and was placed about three feet above the water. The eggs, three in number, were in an advanced state of incubation. All the nests of the White Ibis contained young birds from one to two weeks old."

The eggs of *Platalea melanorhyncha* are similar to those of its near ally *P. leucorodia*, of Europe and Southern Asia; they are elongate-oval in form, slightly pointed at the smaller end, and of a dull chalky-white ground colour, with ill-defined blotches and smears of yellow- and pale reddish-brown almost uniformly distributed over the surface of the shell; one specimen (C) is more sparingly but distinctly marked, and has a few bold darker blotches on the large end. Length, (A) 2.73×1.73 inch; (B) 2.65×1.68 inch; (C) 2.6×1.7 inch.

It is remarkable the partiality Spoonbills have for breeding in company with Ibises. Mr. Hume in his "Nests and Eggs of Indian Birds" records *Platalea leucorodia* breeding on trees in company with the Pelican-Ibis (*Tantalus leucoccephalus*), also near colonies of the Shell-Ibis (*Anastomus oscitans*).

ARDETTA PUSILLA, Vieillot.

Though a comparatively rare species the Minute Bittern is widely distributed in suitable localities over most parts of Eastern Australia. In New South Wales it still frequents the neighbourhood of Sydney, specimens having been recently presented to the Trustees of the Australian Museum that were procured on the marshy grounds at the mouth of Cook's River during January, 1895. A freshly shot specimen was also received in the same month from a correspondent at Narromine, a pastoral and agricultural district, situated on the banks of the Macquarie River, and about 300 miles west of Sydney. It appears, however, to be more freely distributed on the swamps in the vicinity of the Murray River, for on several occasions Mr. Evered has been



successful in finding its nests and eggs near Mathoura. Mr. Kershaw, to whom I am also indebted for the loan of the eggs of this species for description, has kindly sent the following note relative to the taking of them :—"Mr. H. G. Evered found the nest of the Minute Bittern, containing four fresh eggs, in a swamp near Mathoura, New South Wales, during November, 1893. It was an open nest, composed of dead leaves of aquatic plants, and grasses and herbage growing about the swamp, and was fastened to several reeds just above the surface of the water. The bird was seen on the nest, and one was captured alive."

The eggs of the Minute Bittern are oval in form and pure white, the texture of the shell being very fine and the surface dull and lustreless. Length, (A) 1.13×0.98 inch; (B) 1.26×1 inch. Like the eggs of all birds laid in similar situations, they soon become dirty and nest-stained.

NOTE ON THE CORRECT HABITAT OF *PATELLA*
(*SCUTELLAstra*) *KERMADECENSIS*, PILSBRY.

By T. F. CHEESEMAN, F.L.S., CURATOR OF THE AUCKLAND MUSEUM.

(Communicated by the Secretary.)

Some months ago, Prof. F. W. Hutton drew my attention to a communication from Mr. Brazier printed in the Proceedings of the Linnean Society of New South Wales (Vol. ix., 2nd Ser., p. 183) in which it is stated that South Africa is the true habitat of *Patella kermadecensis*, and that Mr. Pilsbry was mistaken in supposing that his specimens came from the Kermadec Islands. Apparently, Mr. Brazier arrives at this conclusion from the fact that a specimen in his possession, originally obtained from a New Zealand dealer notoriously inaccurate in the localities assigned to his specimens, has adhering to it two individuals of *Patella cochlear*, Born, a species known to inhabit the Cape of Good Hope. He also considers it extremely improbable that such a large and conspicuous species as that described by Mr. Pilsbry should have been overlooked by the late Mr. John MacGillivray, the naturalist attached to H.M.S. "Herald," which ship, under the command of Capt. Denham, in the year 1854, made a stay of nearly four weeks at Sunday Island, the largest of the Kermadec Group.

As Mr. Pilsbry's types were collected by myself at Sunday Island, I wrote a few lines with the intention of forwarding them to the Society. Just at that time, however, I received the following part of the "Proceedings," in which I noticed that Mr. Hedley had, on the strength of information furnished by my friend Mr. C. Spencer, again asserted the claims of the Kermadec Islands (see Vol. ix., 2nd Ser., p. 465). Thinking that this was

sufficient to set the matter at rest, I threw aside what I had written. Unfortunately I did not then notice a subsequent communication from Mr. Brazier printed in the same number (p. 566), in which, while granting that *Patella kermadecensis* might have been collected at Macaulay Island, one of the smaller islands of the group, he still declined to admit its nativity in Sunday Island. Perhaps I may now be allowed to mention what must be regarded as conclusive evidence on the point.

In July, 1887, the New Zealand Government despatched the steamer "Stella" to the Kermadec Islands for the purpose of annexing them to the colony, and I was kindly granted permission to accompany the expedition. My time was mostly given to an examination of the botany of the group; but while engaged in this work I was able to pay some attention to the fauna. We first landed on Sunday Island on the north side, and I then noticed (as in fact all the members of our party did) that the rocks in the vicinity of the landing place were covered with large limpets, four or five inches in diameter. Attempts were made to collect some of them, but they could not be reached from the boat, and the violent surf breaking on the rocks made it impossible to get at them from the shore. Two days later, we landed at Boat Cove, on the eastern shore of the island. In this locality the limpets were even still more plentiful, and as it was low water at the time I was able to knock several off the rocks with a spade. While I was on shore botanising our boatmen collected quite a large number, most of which were given to me. The next day they were seen in profusion on Meyer Island, an outlying rock on the north side of Sunday Island. In short, we noticed them on every part of the coast that was at all suitable; and I have no hesitation in saying that in calm weather it would be quite possible to load a small vessel with them, so numerous are they. Afterwards, we found that they were equally plentiful on the shore of Macaulay Island and the other small islands of the group.

Soon after my return to Auckland, I forwarded specimens to several of the New Zealand Museums, and to private collectors, both in New Zealand and abroad. Among others, several

specimens were sent to Mr. E. W. Roper, of Revere, Massachusetts, and two of these were given by him to Mr. Pilsbry. Upon these the original description printed in the "Nautilus" is founded.

Since my visit, great numbers of the *Patella* have been brought to New Zealand by the officers and crew of the "Hinemoa," which vessel now regularly visits the group once a year. On one occasion a sackful was brought to me at the Museum, and offered for a few shillings. Having a stock sufficient for my requirements, I did not purchase, and the sack was eventually sold to the dealer alluded to by Mr. Brazier. Doubtless the shell has passed into the hands of many collectors from this source.

As Mr. Brazier remarks, it is somewhat curious that such a conspicuous species was not noticed by Mr. MacGillivray. But I believe that the landing place principally used during the visit of the "Herald" was Denham Bay, on the west side of the island. This is sandy, and of course anyone landing there would fail to see the *Patella*. The "Herald," too, had remarkably rough weather during almost the whole of her stay, and that would effectually prevent the rocky beaches from being searched, as our own experience with the "Stella" amply proved.

I may conclude by saying that the presence of a large *Patella* in the Kermadec Group was alluded to in my account of the botany of the Group (Trans. N.Z. Institute, Vol. xx., p. 165) and in Mr. Percy Smith's official report to the New Zealand Government ("The Kermadec Islands, their capabilities and extent," p. 27).

DESCRIPTIONS OF NEW SPECIES OF AUSTRALIAN COLEOPTERA.

BY ARTHUR M. LEA.

PART II.

DYTISCIDÆ.

LANCESTES OCULARIS, n.sp.

Subconvex, highly polished. Piceous-black; head with a testaceous blotch in its middle; anterior half of prothorax testaceous, except behind the emargination and a narrow indistinct stroke at the middle; each elytron with eight narrow longitudinal stripes—1st and 2nd joined and barbed at apex, open behind, 3rd and 4th joined at base and apex, 5th bifurcate at its base, joined to the 6th at about a third from the apex, between the 5th stripe and the base is an irregular circle with an extension behind, 7th and 8th soldered at the shoulders—near apex connected with 4th; legs, antennæ and palpi reddish, the posterior legs tinged with piceous. Above very densely and extremely minutely punctate; head with two transverse punctures on each side; prothorax with a row of feeble closely connected punctures near apex, with some almost obsolete on each side near base; elytra with two very feeble rows; sterna indistinctly wrinkled; intermediate femora with a row of feeble punctures.

Head very smooth; without impressions at sides of eyes; antennæ thin, passing intermediate coxæ. Prothorax widely transverse, narrower in front than behind; widely emarginate at apex, base feebly bisinuate; angles acute, the posterior but little produced; prosternal keel narrow, lanceolate, basal half margined, received into a narrow mesosternal excavation. Elytra wider than prothorax, widest about the middle; not quite covering abdomen. Tibiæ with setæ and spurs at their apices, spurs to

posterior long and thin—the longest three-quarters the length of the first tarsal joint. Length $8\frac{1}{2}$, width $4\frac{1}{3}$ mm.

Hab.—Donnybrook, West Australia.

I have two specimens—both females—which agree in all particulars. Besides the markings, the present species differs from *L. lanceolatus* in being shorter and broader, the sterna more feebly wrinkled, and prosternal keel broader at base, mesosternal excavation less sharp.

MYCETOPHAGIDÆ.

TRIPHYLLUS MULTIGUTTATUS, n.sp.

Suboval, slightly convex, above feebly, undersurface moderately shining. Above dark brown; head in front obscure red, eyes black; prothorax with the margins, and an irregular spot on each side of the base, elytra with the margins and numerous spots, testaceous; these spots are elongate, somewhat irregular in number (from eleven to fourteen on each elytron), an oblique one on each side of the scutellum, behind it with its apex at the middle is an irregular spot, sometimes Ω but oftenest f-shaped, the spots behind the middle sometimes uniting to form a very irregular transverse fascia, a large round spot near the apex (sometimes united with it); undersurface ferruginous-red, legs paler. Tibiæ tipped on the outer apex with short black setæ, the inner with a narrow spur. Above densely and obsoletely, undersurface very minutely punctate; elytra very feebly striate.

Head triangular; eyes large, coarsely faceted; antennæ inserted immediately in front of the eyes, not reaching base of prothorax. Prothorax broadly transverse; apex widely and shallowly emarginate, base feebly bisinuate; posterior angles acute. Scutellum small, widely transverse, semicircular. Elytra about twice as long as head and prothorax combined, at their widest near the base, where they are slightly wider than prothorax; base truncate, shoulders feebly rounded. Femora and tibiæ flattened. Length $2\frac{1}{2}$ – $2\frac{3}{4}$, width $1\frac{1}{4}$ – $1\frac{1}{3}$ mm.

Hab.—Richmond River, N.S.W.

Differs from *T. intricatus* by its darker colour, different pattern, smaller size, less distinct puncturation, more prominent eyes, longer antennæ, and broader femora.

TRIPHYLLUS MINOR, n.sp.

Suboval, slightly convex, shining. Above and the legs reddish-testaceous, undersurface darker; head piceous-brown (in some specimens paler at apex); prothorax testaceous-red (occasionally brown): elytra with three irregular brown fasciæ, the two posterior sometimes connected along the suture and lateral margin, the basal oftenest represented by a large spot on each side of the scutellum, and a smaller spot on the shoulder; median fascia largest near the sides, sometimes obliquely connected with the basal; apical sometimes appearing as two spots and sometimes occupying almost the entire apex: palpi and antennæ testaceous, the latter darkest at apex. Clothed all over—sparsest on prosternum—with short, yellowish pubescence; tibiæ with a number of spurs at their apices, some of them appearing to be obtusely serrate. Above densely covered with small, deep punctures; elytra feebly punctate-striate; undersurface irregularly transversely strigose, and obsoletely punctate.

Head transverse, apex rounded; eyes rather small and prominent; antennæ inserted a little distance in front of the eyes, reaching anterior coxæ. Prothorax broadly transverse; apex almost truncate, base truncate; posterior angles acute. Scutellum small, widely transverse, apex almost truncate. Elytra scarcely twice as long as head and prothorax combined, widest at the base; base truncate, shoulders very feebly rounded. Femora and tibiæ flattened. Length 2, width $\frac{4}{5}$ mm.

Hab.—Sydney, Pitt Town, Inverell, Forest Reefs, Tweed, Richmond, Clarence, and Hawkesbury Rivers, N.S.W. (Lea). Brisbane, Queensland (Mr. A. J. Coates).

This species in general appearance and pattern closely resembles *T. intricatus*, from which species it may be distinguished by its much smaller size (subject to but trifling variation), apex of

prothorax wider and less deeply emarginate, head darker, tibiae differently spurred, somewhat feebler puncturation, and its more sober colour. My Pitt Town specimens (three) were taken from the nest of a Diamond Sparrow, and some of the Sydney ones from the nests of a Processionary Moth.

DIPLOCÆLUS PUNCTATUS, n.sp.

Subparallel, subdepressed, shining. Dark brownish-red, elytra dark red, legs bright red. Above with long yellowish pubescence, longest at the sides, much shorter and sparser on the undersurface; tibiae with short spurs and setæ at their apices. Head densely and strongly, prothorax as strongly but not so densely punctate, with several rows of quadrate punctures at the sides; elytra striate-punctate, the punctures large, quadrate, interstices minutely punctate; sterna with large shallow punctures; abdominal segments minutely punctate.

Head transverse (when at rest); eyes moderately prominent; antennæ widely separated, scarcely reaching base of prothorax, two basal joints rather large, middle joint of club widely transverse, much wider than basal, apical subcircular. Prothorax transversely oblong; apex widely and feebly emarginate, base very feebly—if at all—bisinuate; posterior angles almost rectangular; sides narrowly margined and narrowly bicostate; base feebly impressed in the middle. Scutellum very narrowly transverse. Elytra about one and a half times as long as head and prothorax combined, base truncate, shoulders rounded, scarcely wider than prothorax. Basal segment of abdomen with two oblique lines on each side. Legs short, tibiae straight and widening to apex. Length $2\frac{3}{4}$, width 1 (vix) mm.

Hab.—Richmond River, N.S.W.

From *D. fasciatus*, the present species may be distinguished by its narrower, more parallel outline, absence of elytral fascia (though in that species it is sometimes almost obsolete), less convex form, shorter antennæ, with shorter club, more sober colour, and somewhat feebler puncturation.

DIPLOCÆLUS LATUS, n.sp.

Short, thick, subdepressed, shining. Chocolate-brown; lower surface, legs, and antennæ paler. Clothed all over with moderately long pubescence, longest and blackest above, shortest and yellowish beneath. Very minutely punctate all over; the head with dense and rather small punctures, larger and sparser on prothorax; elytra seriate-punctate, the punctures moderately large and subquadrate at base, feebler towards apex; sterna distinctly and not very densely punctate.

Head transverse; eyes prominent; antennæ widely separated, not passing anterior coxæ, two basal joints of club transverse—the middle wider than basal, apical joint circular. Prothorax broadly transverse, very little wider behind than in front; sides slightly rounded, apex feebly and widely emarginate, sides narrowly margined and with traces of costæ. Scutellum very small, widely transverse. Elytra about twice as long as head and prothorax combined, not twice as long as wide; base truncate, shoulders scarcely rounded, sides subparallel to near the apex. Basal segment of abdomen with two oblique lines on each side, both commencing at the middle of the base, the first straight and terminating at the apex; the second curvilinear, terminating before the apex. Legs rather short and flat; tibiæ dilating towards apex; claw joint of posterior tarsi as long as the others combined. Length $2\frac{3}{4}$, width $1\frac{1}{4}$ mm.

Hab.—Donnybrook, W.A.

Proportionately broader than any species known to me.

DERMESTIDÆ.

ANTHRENUS SOCIUS, n.sp.

Subparallel, subdepressed, shining. Black; undersurface piceous-black, margined with dull red at the base and sides of the prothorax, and at the apex of the abdominal segments (except the apical), legs also dull red; club of antennæ and palpi ferruginous. Above covered with short blackish hair, very short on

the head, sparse on the prothorax (each hair rising from a puncture), and rather dense and longest on elytra, on which also there are a few very indistinct grey hairs on the basal two-thirds; on the undersurface the pubescence is very short and greyish-black. Above densely and not very minutely punctate, the punctures strongest on elytra, sparsest on prothorax, and densest on head; the whole surface covered with microscopic punctures, most visible on scutellum; undersurface and femora densely and shallowly punctate, punctures densest on prosternum.

Head rather dull, transverse, feebly transversely impressed between the eyes and antennæ, and with a very indistinct median line; antennæ short, immersed in prothorax to about the middle of its sides, 1st and 2nd joints somewhat large, between the 2nd and club the joints are very short and transverse; club slightly longer than the rest of antennæ, composed of three joints, of which the 2nd is strongly transverse, it is about half the length of the 3rd (which is scarcely transverse), the 1st is transverse. Prothorax polished, strongly transverse, the sides narrowly margined, feebly depressed along the base; anterior angles slightly prominent, giving the apex a feebly emarginate appearance, which otherwise would be truncate; base shallowly bisinuate. Scutellum small, transverse, curvilinearly triangular. Elytra parallel-sided to near the apex, about one and a half times as long as wide, shoulders rounded, base feebly depressed on each side, suture feebly depressed at apex. Prosternum with antennal grooves broad, feebly strigose (to the naked eye appearing highly polished); keel narrow, feebly carinate. Metasternum with a feeble impression down its middle. Legs—especially the tarsi—slender.—Length $2\frac{1}{3}$, width $1\frac{1}{4}$ (vix) mm.

Hab.—Sydney.

I obtained my unique specimen under a stone in the nest of a small black ant; there were numerous larvæ and a few pupæ, most of which I left, hoping to procure some additional imagines on a future occasion.

EUCNEMIDÆ.

LYCAON MASTERSI, Macl. (*Hemiopsida*, Macl.), Mast. Cat. Sp. No. 3308.

This species was described by Sir William Macleay as belonging to the ELATERIDÆ. It certainly belongs to the genus *Lycaon*, and is, I think, the species described by Bonvouloir as *L. novus*.

DASCILLIDÆ.

HELODES SCALARIS, n.sp.

Subdepressed, shining. Above piceous-black, undersurface piceous-red. Above densely clothed with short ashen pubescence, densest on the head; on the undersurface the pubescence is very short. Densely and minutely punctate all over.

Head broad, flat, several shallow irregular impressions in the middle; eyes large, prominent, finely faceted; antennæ flattened, reaching posterior coxæ, 1st joint large, thick, 2nd very small, 3rd longest of all, 4th-10th gradually decreasing in length, 11th slightly longer than 10th. Prothorax about three times as broad as long, narrowly margined all round, widely emarginate in front, the middle scarcely lobed; base feebly bisinuate; anterior angles scarcely reaching the middle of the eyes. Scutellum triangular, flat, its sides straight. Elytra at base slightly broader than prothorax, scarcely widening to middle, and then as gradually decreasing to near apex, narrowly margined; four costæ on each elytron—running from near base to near apex, the lateral one shortest and least distinct. Abdominal segments (except apical) with a shallow fovea on each side. Tibiæ grooved outwardly, the sides minutely serrate. Length 11, width 7 mm.

//ab.—Galston, N.S.W. (Mr. D. Dumbrell).

The above is the description of my largest specimen; I have two others which are much smaller, the smallest measuring 7 × 4 mm.; it differs also in being more shining, paler beneath; in the antennæ which are much longer (reaching apex of abdomen), and

having the apical joint fully as long if not longer than the third, the head and abdominal segments without impressions. Mr. Dumbrell informs me that he captured the three specimens whilst crawling out of the same burning log.

MALACODERMIDÆ.

SELENURUS GRANULATUS, n.sp.

♂. Elongate, shining, depressed. Testaceous-red; head with a small oblique brown marking close to eyes, palpi black, basal joints of antennæ more or less diluted with red, the rest black; prothorax with the apical third black—except on a slight interruption in the middle; elytra coppery green; tip of femora, apical half of tibiæ and the tarsi black; abdomen with the segments having on the undersurface black markings at the sides, the apical only entirely black, on the upper surface there is in addition a black macula in the middle of each; eyes dark brown. Covered all over—densest on elytra—with short white pubescence; the upper surface in addition with short black setiform hairs—most noticeable on prothorax. Minutely punctate all over.

Head feebly transverse; eyes moderate, not very prominent; antennæ slender, reaching or slightly passing posterior coxæ. Prothorax feebly transverse; wider than head, not much wider at apex than at base; irregularly and shallowly depressed; base margined, sides feebly reflexed. Elytra not twice as long as head and prothorax combined, each somewhat wedge-shaped; the whole surface densely covered with small, shining, rounded elevations, giving it an embossed appearance. Legs moderately long, femora thickened, posterior tibiæ bent. Length to apex of elytra $5\frac{1}{4}$, of abdomen $6\frac{1}{2}$; width $1\frac{1}{5}$ mm.

♀. Differs in being larger, broader, head narrower, with shorter antennæ; the black of prothorax appearing as lateral maculæ; the disk smoother, &c. Length to apex of elytra 6, of abdomen $7\frac{3}{4}$; width $1\frac{2}{3}$ mm.

Hab.—Bunbury, West Australia.

I have beaten numerous specimens into the umbrella from several dwarf *Eucalypts* growing almost on the sea-beach; for a long time, even on hot days, they feign death, rolling up the abdomen, tucking in the antennæ, and then lying on their sides.

SELENURUS TRICOLOR, n.sp.

♂. Elongate, feebly shining, depressed. Head black, sides immediately in front of the eyes testaceous; prothorax testaceous, a large black blotch—occupying most of the upper surface—irregularly W-shaped; scutellum black; elytra dark bluish-green; abdomen testaceous, the lower surface having the 1st segment immaculate, 2nd with a small spot on each side, 3rd with the middle of base, 4th with entire base, the 5th (except apex) and the entire 6th and 7th black, the markings on the upper surface are somewhat different, there being more black towards the sides; meso-, and metasternum, except sides, legs and antennæ black; base of coxæ testaceous. Clothed all over—sparsest in the middle of meso- and metasternum—with short pale pubescence. Very minutely punctate all over, except on the elytra where they are dense, rugose, and shallow, but obliterated at apex.

Head not much longer than wide; eyes rather large and prominent; antennæ slender, reaching posterior coxæ; 1st joint as long as 2nd-3rd combined, 2nd very short, 4th as long as 1st, 4th-11th equal or very slightly diminishing to apex. Prothorax the width of head; irregularly depressed; strongly rounded in front, sides constricted near base, base feebly sinuate. Scutellum small, truncate, a shallow depression in its middle. Elytra not one and a half times the width of prothorax at base, and about one and a half times the length of head and prothorax combined; each wedge-shaped; margins and suture thickened—especially towards apex; with traces of costæ (visible to the naked eye, but much confused with a Coddington lens). Penultimate segment of abdomen widely emarginate. Legs long and thin. Length to apex of elytra 6, of abdomen $8\frac{1}{2}$; width $1\frac{3}{4}$ mm.

Hab.—Blackheath, N.S.W. (Mr. G. Masters).

One specimen has much less black about the abdomen and sterna, and there is a small testaceous macula situated near the apex of, and common to both elytra. The species comes closest to *S. variegatus*, which Mr. Masters also captured in considerable numbers.

HETEROMASTIX BICOLOR, Bohem.; Mast. Cat. Sp. No. 3389.

Of this species only the male has been described. I have several pairs obtained *in copula*. The female differs in having the antennæ less thick, the tenth joint similar in shape to the ninth, and in the apical joints being piceous, only the first three or four joints being reddish-testaceous.

HETEROMASTIX GAGATICEPS, n.sp.

♂. Oblong, shining, subdepressed. Black; prothorax, mandibles, tip of femora, basal fourth of posterior, basal two-fifths of intermediate, and almost the entire anterior tibiæ testaceous; antennæ with the three basal joints—and the fourth beneath—testaceous, the others black; palpi and tarsi piceous; claws reddish; eyes blackish-brown. Head and prothorax sparsely clothed with short yellowish pubescence, that on the head very short; elytra more densely clothed with short sub-erect pubescence: on the undersurface it is yellowish-grey and rather dense (sparsest on abdominal segments). Head and prothorax minutely, elytra densely, shallowly, and somewhat rugosely punctate, punctures almost obliterated at base; undersurface and legs densely and minutely punctate.

Head transverse, a shallow transverse impression on each side between the eyes; eyes large, prominent; antennæ inserted equidistant from each other and from the middle of the eyes, reaching posterior coxæ, joints rather thick, 1st as long as 3rd-4th combined, 2nd about half as long as 3rd, 3rd-9th obconic, subequal or very gradually diminishing, 10th stouter, its apex obliquely truncate, 11th as long as 9th-10th combined, somewhat dumb-bell shaped, apex pointed. Prothorax broadly transverse, slightly widest near the apex; apex truncate, base somewhat rounded; all

the angles rounded; margins narrowly reflexed. Scutellum small, curvilinearly triangular. Elytra parallel-sided almost to extreme apex, shoulders feebly rounded; more than twice as long as head and prothorax combined; in certain lights with feeble traces of costæ. Penultimate segment of abdomen deeply and narrowly excised. Legs compressed, moderately long, anterior tibiæ somewhat bent, penultimate joint of tarsi deeply cleft, in the anterior the lobes widely diverging. Length $5\frac{1}{2}$, width $1\frac{1}{3}$ mm.

♀. Differs in being slightly broader, in having shorter and simple antennæ, lobes to penultimate joint of anterior tarsi not widely divergent; the colour is the same, except the amount of paleness of the four posterior tibiæ.

Hab.—Sydney, Galston, Clifton, N.S.W.

From the description of *H. dilaticollis*, the present species appears to differ in the colour of the legs, and in the dilatation of the prothorax.

HETEROMASTIX McDONALDI, n.sp.

♂. Oblong, shining, subdepressed. Black; prothorax clear testaceous, first two joints of antennæ testaceous beneath, piceous above; mandibles dull red; palpi testaceous, apical joint piceous; anterior legs with the apex of femora and the base of tibiæ obscure red. Head almost glabrous; prothorax sparingly pubescent; elytra moderately densely clothed with short semi-upright ashen pubescence; on the undersurface the pubescence is darker than on the elytra and very short, except at apex of abdomen. Head strongly punctate, the punctures as deep but not quite as wide at the base as in the middle, almost obliterated at apex; undersurface and legs densely and minutely punctate.

Head transverse, an irregular impression and a feeble carina between the eyes; eyes rather small, prominent; antennæ inserted equidistant from each other and from the middle of the eyes, reaching the middle of elytra, 1st joint not as long as 2nd-3rd combined, 2nd more than half the length of 3rd, 3rd-8th obconic, subequal, 9th suboval, broader and nearly as long as 7th-8th combined, emarginate at its outward apex, 10th slightly longer

and narrower than 8th, 11th elongate-ovate, about one and a half times as long as 10th. Prothorax transverse; apex truncate, base rounded; anterior angles scarcely, posterior moderately strongly rounded; sides subparallel; margins narrowly reflexed; median line feebly traceable. Scutellum small, depressed in the middle, truncate at apex. Elytra about two and a half times as long as head and prothorax combined; parallel-sided almost to extreme apex, shoulders feebly rounded; without traces of costæ. Penultimate segment of abdomen semicircularly excised. Legs slender, tibiæ straight, penultimate joint of tarsi deeply cleft, in the anterior the lobes widely diverging. Length $4\frac{1}{2}$, width $1\frac{1}{4}$ mm.

Hab.—Armidale, N.S.W. (Mr. D. McDonald).

HETEROMASTIX MIRABILIS, n.sp.

♂. Oblong, shining, subdepressed. Black; head, prothorax and scutellum clear testaceous, antennæ with the entire basal and the second joint beneath testaceous, palpi piceous; anterior legs testaceous, apex of tibiæ infusate, tarsi piceous; four posterior legs piceous, their coxæ and trochantins obscure testaceous. Head glabrous, prothorax almost so; elytra moderately densely clothed with ashen suberect pubescence; undersurface and legs with shorter, denser and paler pubescence than on elytra. Head and prothorax highly polished and microscopically punctate; elytra very shallowly and obsoletely punctate, especially at base and apex; undersurface and the legs densely and minutely punctate.

Head almost as long as the width across eyes, shallowly impressed between them; eyes rather small, prominent, and quite round; antennæ short, thick, reaching intermediate coxæ; the distance between them greater than that between them and the middle of the eyes, 1st joint as long or slightly longer than 2nd 3rd combined, 2nd about two-thirds the length of 3rd, 3rd one and a half times longer than 4th, 4th-6th subequal, 6th slightly transverse, 7th-10th obliquely transverse, all of them different in shape, 10th large, rounded on its outer and hollowed on its inner apex, 11th large, flattened, base oblique, its outer edge rounded, and about half as long as the inner (which is constricted in the

middle), hollowed internally, its extreme length equal to that of the three preceding joints. Prothorax broadly transverse, about as long as the head; apex truncate, base rounded; angles obliquely rounded; widest and somewhat angularly produced near the apex; lateral margins rather broadly reflexed, the others narrowly; median line feebly traceable at base. Scutellum triangular, almost concealed by the overlapping prothorax. Elytra parallel-sided almost to extreme apex, not two and a half times as long as head and prothorax combined; shoulders feebly rounded, each with traces of about three costæ. Penultimate segment of abdomen deeply and semicircularly excised. Legs slender, anterior tibiae very feebly bent, lobes of penultimate joint of anterior tarsi widely diverging. Length $4\frac{1}{3}$, width $1\frac{1}{4}$ mm.

Hab.—Barron Falls, North Queensland (Mr. Albert Koebele).

The extraordinary antennæ of this species will at once distinguish it from any of its congeners.

HETEROMASTIX CRASSICORNIS, n.sp.

♂. Black; prothorax, muzzle and undersurface of head, undersurface of basal two-thirds of antennæ, and the entire basal joint, anterior legs, except tarsi, intermediate trochantins, apical half of femora, basal half of tibiae, and posterior knees, testaceous; rest of the legs piceous-black or brown; eyes dark brown. Elytra, sterna, and abdomen moderately densely clothed with short greyish pubescence. Elytra densely, minutely, and obsoletely punctate, meso- and metasternum minutely but visibly punctate.

Head—excluding mandibles—widely transverse, eyes rather large and prominent; antennæ thick, increasing to apex, reaching posterior coxæ, 1st joint slightly longer than 2nd-3rd combined, 2nd about half the length of 3rd, 3rd slightly longer than 4th, 4th-9th subequal, 10th-11th very large and thick, their combined length equal to 4th-9th combined, closely joined, 10th excavated beneath for the reception of the base of the 11th, 11th with depressions at its base above and on the sides, its upper edge as long as 10th, its lower twice as long. Prothorax about twice as wide as long, sides and base narrowly reflexed, sides feebly pro-

duced near the middle. Elytra parallel-sided or very slightly increasing almost to apex, about twice as long as head and prothorax combined, in some lights with very feeble traces of costæ. Apex of penultimate segment triangularly excised. Tibiæ straight. Length $4\frac{1}{3}$, width $1\frac{1}{2}$ mm.

♀. Differs in being less robust, with shorter, thinner and simple antennæ, and in being dingier in appearance.

Hab.—Cairns, N. Queensland (Macleay Museum).

HELCOGASTER FOVEICEPS, n.sp.

♂. Depressed, suboblong, shining. Black; head (except sides behind the eyes, extreme base, and the middle of the base beneath), antennæ (except joints 4th-7th), prothorax, apical third of four anterior and tip of posterior tibiæ, reddish-testaceous; four posterior tibiæ and tarsi piceous, anterior somewhat paler; eyes dark brown. Head moderately densely and shallowly punctate, prothorax more feebly; elytra, abdomen, and undersurface obsoletely punctate. Above with sparse greyish hairs, a few at the base of the head, short on prothorax, longest on elytra and sides of abdomen; undersurface with moderately long straggling hairs, densest on abdominal segments; tibiæ moderately densely clothed with whitish pubescence.

Head transversely suboblong; two wide impressions occupying most of upper surface, separated in front by an irregular elevation (which when looked at from behind appears three-pointed), a fovea on each side behind it; eyes moderate, lateral, scarcely prominent; antennæ scarcely reaching posterior coxæ, inserted almost at apex, equidistant at their bases with the middle of the eyes, 1st joint scarcely as long as 2nd-3rd combined; 2nd scarcely shorter than 3rd, 3rd-10th subequal, 11th not as long as 9th-10th combined. Prothorax transverse, scarcely as wide as head; apex truncate, base rounded, sides widest in front; anterior angles scarcely, posterior moderately rounded; median line feebly traceable, a transverse impression at base. Scutellum almost concealed by prothorax. Elytra about one and a quarter times as long as head

and prothorax combined, slightly wider than head and considerably wider than prothorax at base; shoulders feebly rounded, sides gradually widening to near the apex, apex almost truncate. Legs slender, tibiæ straight, first joint of anterior tarsi large, and concealing the second. Length to apex of elytra $1\frac{1}{2}$, of abdomen $2\frac{1}{2}$; width $\frac{2}{3}$ mm.

♀. Differs in having only the muzzle, four basal joints of antennæ and the knees reddish-testaceous, anterior tibiæ piceous-red. Head scarcely transverse, densely and strongly punctate, with a number of shallow impressions; antennæ shorter, prothorax less transverse, basal impressions very shallow, median line invisible, simple tarsi, &c.

Hab.—Sydney.

From the description of *H. impressifrons* (of which the male only is described) the male of the present species differs in the colour of the palpi, in having more joints of the antennæ reddish, in the colour of the elytra, and in several structural details. I have a specimen in which the elytra have an indistinct greenish tinge. I have a pair obtained *in copula*, so can be certain of the sexes; there are several species in which both male and female strongly resemble the female of the above.

HELCOGASTER GAGATINUS, n.sp.

♂. Elongate, flat, shining. Black; basal third of antennæ and anterior legs obscure testaceous. Above with sparse and rather long black hairs. Almost impunctate.

Head about as long as wide; two longitudinal foveæ commencing on a level with the middle of the eyes, approximating and becoming shallower in front; foveæ of undersurface moderately large, almost united; antennæ rather thin, scarcely reaching intermediate femora. Prothorax about as long as wide, narrower than head; almost without impressions at base; base narrowly margined. Elytra longer than head and prothorax combined, slightly wider than head, sides subparallel, apex conjointly feebly rounded. Basal joint of anterior tarsi large, a curved comb on its inner edge. Length to apex of elytra $1\frac{2}{3}$, of abdomen $2\frac{1}{2}$; width $\frac{3}{5}$ mm.

♀. Differs in being broader (especially the abdomen), with only the base of the antennæ testaceous, the head with several very shallow indistinct impressions in front. Length to apex of elytra $1\frac{1}{2}$, of abdomen $3\frac{1}{4}$; width $\frac{2}{3}$ mm.

Hab.—Galston, Sydney, Forest Reefs.

I can be certain of the sexes of this species, having three pairs beaten from the same bush at Galston.

HELCOGASTER RUFICORNIS, n.sp.

♂. Elongate, flat, shining. Black; elytra piceous black; head, except basal half of upper surface, antennæ, apex of prothorax, and knees, obscure reddish-testaceous. Elytra sparsely pubescent, rest of the surface almost glabrous. Almost impunctate.

Head strongly rounded, transverse; depressed in front; an excavation between the eyes, triangularly open behind almost to base; seen from in front with four very feeble tubercles; foveæ of undersurface moderately large; antennæ scarcely reaching intermediate coxæ, equal in thickness throughout. Prothorax decidedly transverse, as wide as head, apex truncate; a feeble impression at base; middle of apex slightly raised. Elytra not much longer than head and prothorax combined, at base wider than head, gradually increasing to apex; each feebly separately rounded. Basal joint of anterior tarsi moderately large, a curved comb on its inner edge. Length to apex of elytra $1\frac{3}{4}$, of abdomen $2\frac{3}{4}$; width $\frac{2}{3}$ mm.

Hab.—Sydney.

I undoubtedly possess females of both this and the following species, but cannot satisfy myself as to their identity, as they are equally common. The present species differs from the preceding in being less parallel, in its differently coloured head and antennæ; and also by the impressions of the head; from the following it differs in the colour of the prothorax, and in its more rounded head, with somewhat different impressions.

HELCOGASTER CANALICULATUS, n.sp.

♂. Elongate, flat, shining. Black, muzzle testaceous; knees obscurely brownish-testaceous; antennæ obscure testaceous-brown,

the basal and apical joints lighter; eyes dark brown. Elytra sparsely pubescent, rest of the body almost glabrous. Almost impunctate.

Head decidedly transverse, depressed in front; a canal extending almost from base to apex, its sides in the middle marked by a small tubercle; seen from in front with four feeble tubercles; foveæ of undersurface small, and rather widely separated; antennæ passing intermediate coxæ, equal in thickness throughout. Prothorax decidedly transverse, scarcely the width of head, apex truncate; a feeble impression at base; middle of apex slightly raised. Elytra not much longer than head and prothorax combined, at base slightly wider than head, gradually increasing to apex; each feebly separately rounded. Basal joint of anterior tarsi not very large. Length to apex of elytra $1\frac{3}{4}$, of abdomen $2\frac{1}{2}$; width $\frac{1}{2}$ mm.

Hab.—New South Wales.

HELCOGASTER MARGINICOLLIS, n.sp.

♂. Depressed, suboblong, shining. Head black, all around the centre obscure red; undersurface and palpi testaceous, mouth parts black; antennæ black, four basal joints testaceous; prothorax reddish-testaceous, the sides in the middle piceous; elytra piceous, an oblique pale stripe extending from the shoulders to the suture at less than half its length; abdomen black; four posterior legs piceous, their femora diluted with testaceous, anterior tibiæ and apex of femora testaceous. Head with short sparse greyish pubescence, and with a few straggling hairs; prothorax on the disk with a few short pale hairs, the sides and front with long straggling blackish hairs; elytra with sparse moderately long hairs, a few long ones at the sides in front; abdomen more densely clothed with blackish hairs, longest at the sides and apex; meso- and metasternum with sparse greyish hairs; tibiæ densely pubescent. Head densely and minutely, rest of the body obsoletely punctate.

Head subquadrate; a deep circular impression in its middle, which is interrupted in front by a two-horned elevation (the horns short, posterior longer); eyes small, scarcely prominent, in the

exact middle of the sides; antennæ inserted close to apex, equidistant at their bases with the front of the eyes, 1st joint slightly longer than 2nd-3rd combined, 2nd a trifle longer than 3rd, 3rd-10th subequal, 11th not quite as long as 9th-10th combined. Prothorax slightly longer and narrower than head, subquadrate, base and apex feebly rounded, angles scarcely rounded, sides parallel; base narrowly margined. Scutellum small, broad. Elytra at base slightly wider than head, not once and a quarter as long as head and prothorax combined; shoulders rounded, sides gradually widening and narrowly margined from about the basal fourth, each separately rounded. Legs slender, posterior tibiæ feebly bent, two short thin spurs at their apices, the other tibiæ with very short spurs. Length to apex of elytra $1\frac{1}{2}$, of abdomen $2\frac{1}{2}$; width $\frac{3}{5}$ mm.

♀. Differs in having the head almost concolorous, with two shallow impressions in front—a feeble carina separating them,—and by having shorter antennæ.

Hab.—Galston (Dumbrell and Lea).

HELCOGASTER PARALLELUS, n.sp.

♀. Very elongate, subparallel, flat, shining. Black; base of antennæ and knees feebly diluted with red. Above and sides of abdomen with sparse and rather long black hairs. Almost impunctate.

Head longer than wide, feebly depressed in the middle, a feeble elevation on each side in front, feebly corrugated at base, sides and undersurface; foveæ of undersurface deep, longitudinal, narrowest and approximating in front: antennæ slender, reaching posterior coxæ. Prothorax distinctly longer than wide, scarcely the width of head across eyes, feebly constricted towards base; a broad and rather sudden impression near base. Elytra very little longer than head and prothorax combined, but distinctly wider; sides gradually increasing to apex, each feebly separately rounded. Length to apex of elytra 2, of abdomen $3\frac{3}{4}$; width $\frac{4}{5}$ mm.

Hab.—King George's Sound, W.A. (Mr. G. Masters).

I have but a single specimen which, though a female, I have described, as its large size—in comparison with those species possessing a black prothorax—should render it distinct.

HELCOGASTER CONCAVICEPS, n.sp.

♂. Depressed, shining. Black; head (except at base), prothorax, femora (except apex of posterior), and two basal joints of antennæ, red; elytra dark steel-blue (almost black); nine apical joints of antennæ, four posterior tibiæ, all the tarsi, and the palpi, piceous-black; trochantins reddish-brown, their bases lighter, posterior femora tipped with piceous, anterior tibiæ reddish, their bases darker; eyes dark brown. Head, prothorax, and elytra with long blackish hairs at the sides, the latter with a few on the disk, the last two with a few small hairs; abdomen with a few longish hairs at the apex; above with sparse minute pubescence, undersurface more sparsely still; meso- and metasternum with a few short hairs, tibiæ with minute whitish pubescence, and a few straggling hairs. Head rather densely and minutely punctate; prothorax minutely punctate, most noticeable at apex; elytra irregularly, abdomen above minutely, undersurface more sparingly punctate; meso-, metasternum and legs minutely but distinctly punctate.

Head transverse; two wide and deep excavations between the eyes, an indistinct carina separating them; eyes small, moderately prominent; antennæ slender, not reaching base of elytra, equidistant at their bases with the front of the eyes, 1st joint almost as long as 2nd-4th combined, 11th one and a half times as long as 10th. Prothorax longer than wide, apex slightly rounded, base truncate, angles equally rounded, sides and base very narrowly margined, sides subparallel; an indistinct longitudinal impression on each side in front, and a broad transverse one at the base. Scutellum almost concealed by the prothorax, the part which is visible widely transverse. Elytra about as long as head and prothorax combined, much wider than prothorax, and wider than head across eyes, base truncate, shoulders square, the sides dilating to about the basal fifth, each separately rounded.

Basal segments of abdomen broad. Legs slender, tibiae straight, first tarsal joint large (externally minutely serrate), concealing the second joint. Length to apex of elytra 2, of abdomen $3\frac{1}{4}$; width $\frac{4}{5}$ mm.

♀. Differs in being broader, prothorax transverse, the head with less red, and less rugosely sculptured, posterior femora piceous, intermediate reddish on apical half only, anterior tibiae reddish-brown and with simple tarsi.

Hab.—Galston.

HELCOGASTER MAJOR, n.sp.

♂. Rather robust, shining, slightly convex, parallel-sided. Reddish-testaceous, apical joints of antennae slightly infusate; four posterior coxae and base of posterior femora infusate; meso-, metasternum and abdomen black; elytra black, with a faint coppery-blue tinge. Above with sparse and rather long black hairs, undersurface with short sparse pubescence. Elytra densely, minutely, and very shallowly punctate.

Head—excluding mandibles—transverse; anterior half deeply excavated, the sides of the excavation near the eyes marked by a raised tubercle, and in front and close to the antennae very slightly raised, the head when viewed from behind appearing to possess four short horns; feebly corrugated at base, sides and undersurface; foveae of undersurface approximate, rather large, open behind; antennae almost reaching apex of elytra, 2nd joint slightly longer than 3rd, 5th-9th strongly serrate internally. Prothorax strongly rounded, transverse, about the width of head, a feeble depression at base and a still feebler interrupted one at apex, Elytra not much longer than head and prothorax combined, at base scarcely wider than head, very feebly increasing to apex, each separately rounded. Basal joint of anterior tarsi large, a black curved comb inwardly, a few short black setae to posterior tibiae. Length to apex of elytra $3\frac{1}{2}$, of abdomen $5\frac{1}{4}$; width $1\frac{1}{2}$ mm.

♀. Differs in being less robust, with simple antennae, and tarsi more obscurely coloured; the head longer, much more shallowly depressed, with two shallow foveae, and without elevations.

Hab.—North West Australia (Macleay Museum).



There is in the Macleay Museum a male—also from the North-West—which differs from the above (of which I have three males under examination agreeing in all particulars) in having the antennæ, except base, the femora, except apex, and all the tarsi brown; the antennæ appear to be shorter, and the head less deeply sculptured; possibly it is a distinct species, but at present I can only regard it as a variety.

HELCOGASTER FUSCITARSIS, n.sp.

♂. Elongate, shining, depressed. Black; head, except base, four basal joints of antennæ and undersurface of 5th, apical half of anterior and two-thirds of four posterior femora, tibiæ, and base of tarsi, testaceous; shoulders very feebly diluted with testaceous. Above with sparse and moderately long blackish hairs, elytra and abdomen with sparse short and obscure greyish pubescence. Head and elytra densely, very minutely and obsoletely punctate.

Head longer than wide; eyes moderately large; a deep and somewhat circular excavation in front, commencing a little behind the eyes, its sides from in front of the eyes marked by a slight carina, which between the antennæ is directed backward and terminates in a feeble tubercle in the middle; base, sides and undersurface feebly corrugated; foveæ rather large, round, rough-walled, approximate; antennæ almost reaching posterior coxæ, feebly thickest in the middle, the two apical joints equal in length. Prothorax a little longer than wide, not the width of head; a broad shallow impression at base; base narrowly margined. Elytra about one and a quarter times as long as head and prothorax combined, at base decidedly wider than head, increasing to apex, each separately rounded internally, and obliquely truncate externally. Basal joint of anterior tarsi not very large. Length to apex of elytra $2\frac{4}{5}$; of abdomen 4; width $1\frac{1}{4}$ mm.

Hab.—Sydney.

HELCOGASTER BRACHYPTERUS, Bohem.; Mast. Cat. Sp. No. 3441.

Only the male of this species has been described; the female differs in having the head narrower and entirely black, the pro-

thorax smaller and less brightly coloured, knees more obscurely coloured, antennæ shorter and thinner; and the whole insect is slenderer.

HELCOGASTER VARIUS, n.sp.

♂. Elongate, depressed, shining. Black; head, except at base and a median line beneath, prothorax, the entire anterior, base of four posterior tibiæ, and tips of femora, reddish-testaceous; elytra with the shoulders testaceous, the marking continued on the sides; antennæ piceous-black, four basal joints testaceous-red, the two following not as dark as those following them; palpi and tips of mandibles piceous, eyes dark brown. Head with short, rather dense, blackish hairs, longest over excavations; prothorax and elytra with a few long hairs, abdomen with sparse hairs, rather long at sides and apex, meso- and metasternum with sparse short hairs, tibiæ rather densely pubescent. Head densely and shallowly punctate, base feebly transversely strigose, prothorax and elytra obsoletely punctate; scutellum minutely and distinctly punctate; abdomen with sparse, moderately strong punctures; legs densely and minutely punctate.

Head obliquely quadrate, with six excavations—three occupying the space between the eyes, of which the central one is smallest, the two outer being rounded, a large one in front, the sides of which are sharply margined, a very small one on each side at its base; eyes moderately large and prominent; antennæ scarcely reaching apex of elytra, equidistant at their bases with the apices of mandibles and middle of eyes, 1st joint as long as 2nd-3rd combined, 2nd-10th subequal, 11th about once and a half as long as 10th. Prothorax longer than wide, and narrower than head, apex truncate, base feebly rounded, angles almost equally rounded, sides subparallel; a broad transverse impression at the base, base narrowly margined. Scutellum small, broadly transverse, apex truncate. Elytra about one and a quarter times as long as head and prothorax combined, wider than head, shoulders feebly rounded, sides gradually widening, and narrowly margined from near the base, apex conjointly rounded, almost truncate. Legs moderate, posterior tibiæ feebly bent, with two thin spurs at

their apices. Length to apex of elytra $2\frac{4}{5}$, of abdomen $4\frac{1}{2}$; width $1\frac{1}{4}$ mm.

♀. Differs in having the head narrower and almost entirely black, a feeble carina separating two shallow impressions in front, a shallow transversely carinate fovea behind it, antennæ thinner, legs with less red.

Hab.—Queanbeyan, Sydney, Clifton, Tamworth, Forest Reefs, N.S.W.

I have a male (from Sydney) which has the antennæ piceous, and with the five basal joints reddish; a female almost without impressions on the head; another specimen (from Clifton) has the elytra entirely black, the middle discal impression on the head very feeble, and the two lateral ones larger than in the type, the whole insect smaller in size (2 mm. to apex of elytra).

var. *PALLIDIPENNIS*.

I have from Tamworth a number of specimens which agree with the type except in having the elytra entirely testaceous, the female with the posterior foveæ scarcely traceable, and the male with the excavations slightly different. As, however, I have a number of close intermediate forms I have thought it advisable not to give them more than a varietal name.

HELCOGASTER TUBERCULATUS, n.sp.

♂. Elongate, shining, depressed. Head reddish-testaceous, apical two-thirds of antennæ infusate, prothorax reddish-testaceous, the anterior half—except near the sides—black; elytra black with—in some lights—a faint purplish reflection; abdomen black; legs brownish-black, trochantins and base of femora more or less reddish-testaceous; eyes dark green. A very few longish hairs at the sides of prothorax and abdomen. Almost impunctate, the elytra very obsoletely.

Head transverse; largely, deeply and transversely excavated, with four distinct sinuosities; in front with a distinctly raised tubercle, flat on its anterior, feebly divided on its posterior edge,

a small tubercle in the exact centre of the head; foveæ of under-surface moderately large, approximate, rough-walled; antennæ slender, reaching intermediate coxæ. Prothorax slightly longer than wide, not the width of head across eyes; somewhat mortar-shaped; convex in front; a broad and rather deep impression at base. Elytra no longer than head and prothorax combined, sides parallel, base and apex parallel. Basal joint of anterior tarsi not very large. Length to apex of elytra $2\frac{1}{3}$, of abdomen 4; width $\frac{4}{5}$ mm.

Hab.—Sydney.

A very peculiar species, abundantly distinct from any here described. I have another species somewhat resembling it but much narrower, and having eyes which, when wet, are of a most brilliant emerald green; unfortunately it has lost its elytra, so I refrain from describing it.

CARPHURUS CRISTATIFRONS, Fairm., Mast. Cat. Sp. No. 3421.

Only the male of this species has been described; the female differs in being broader, without elytral armature, the head much smoother and with slenderer antennæ.

I have specimens from Galston.

CARPHURUS BLACKBURNI, n.sp.

♂. Elongate, shining, depressed. Black; elytra with an obscure purplish reflection; muzzle, two basal joints of antennæ, prothorax, apex of elytra, apex of penultimate abdominal segment, anterior tibiæ, the four posterior more obscure, reddish-testaceous. Clothed all over—densest on abdomen, sparsest on sterna—with long blackish hairs. Head near the eyes rather strongly punctate; prothorax sparsely and minutely, elytra densely, not very minutely and obsoletely punctate; undersurface indistinctly punctate.

Head much longer than wide; eyes small, prominent, the sides rapidly decreasing in width behind them; a small fovea on each side in front; a short ridge behind them, obliquely behind them is a shallow depression, a very narrow impression between the eyes terminating at the ridge; antennæ reaching posterior coxæ, 1st

joint longer than 2nd-3rd combined, 2nd not much shorter than 3rd, 3rd-10th subequal, serrate internally, 11th scarcely once and a half as long as 10th; base and sides finely corrugated; foveæ of undersurface moderate in size, almost connected, walls feebly wrinkled. Prothorax oblong, as wide as head (excluding eyes), angles slightly rounded; a broad shallow impression at base, and a shallower interrupted one at apex. Sides of elytra emarginate at a third from the apex, at the posterior end of this emargination a short stalk—carrying a small globule—projects outwards and a little forwards; this globule is somewhat different in colour to the apex; each separately rounded. Anterior tarsi with basal joint small, not much longer than second. Length to apex of elytra 3, of abdomen $4\frac{3}{4}$; width $1\frac{1}{5}$ mm.

♀. Differs in having the elytra simple, shorter and thinner antennæ, and smaller head.

Hab.—Adelaide (Messrs. Blackburn and Masters); Mt. Lofty, S.A. (Lea).

The colour of this species is very distinct from either of its armed congeners.

CARPHURUS CARINATICEPS, n.sp.

♂. Elongate, shining, depressed. Black; prothorax with a faint purplish reflection and indistinctly diluted with brown; basal third of antennæ and prothorax dull red; undersurface of head, knees, and apices of coxæ obscure red. Above with a few long blackish hairs, undersurface almost glabrous. Head densely, minutely but distinctly punctate; the prothorax and elytra sparsely and obsoletely, flanks of meso- and metasternum minutely, abdomen indistinctly punctate.

Head strongly transverse, with three distinct longitudinal carinæ—one on each side directly behind antennæ and close to the eyes, the third in the middle—commencing at the clypeus and terminating slightly before the others, from some directions all of them appear to be double; antennæ short, reaching posterior coxæ, 1st joint as long as 2nd-3rd combined, 2nd-10th subequal, 2nd sub-cylindric, 3rd-10th broadly obconic, 11th acuminate, as long as

9th-10th combined; corrugate at the sides; foveæ of undersurface almost connected. Prothorax decidedly longer than wide, at its widest the width of the head (excluding eyes); angles rounded, a distinct and rather wide transverse impression at base, none at apex; base narrowly margined. Elytra strongly dilating towards apex, where the width is not much less than their length, each almost obliquely truncate. Length to apex of elytra 2, of abdomen 3; width $\frac{4}{5}$ mm.

Hab.—Sydney.

A small species, which should be easily recognised by the carinate head.

CARPURUS IMPUNCTATUS, n.sp.

♀. Elongate, subparallel, shining, strongly depressed. Head and prothorax reddish, with obscure brownish blotches—in the former towards the sides, in the latter on apical half; antennæ reddish, apical third infusate; elytra black, the basal fourth testaceous, the two colours distinctly separated; abdomen black, base and margins of the second segments reddish; legs brownish-black, tarsi testaceous; undersurface of coxæ, of anterior portion of intermediate, and base of posterior femora, diluted with testaceous. Sparsely clothed with not very long blackish hair, undersurface almost glabrous. Head with a few small punctures, none visible elsewhere.

Head slightly convex, rounded, very slightly longer than wide; an impression commencing almost at base, continuous almost to middle, and then becoming circular, the circle enclosing a low elevation (invisible from some, and appearing tuberculate from other directions); antennæ slender, subcylindrical, almost reaching apex of elytra, 1st joint slightly longer than 2nd-3rd combined, 2nd not much shorter than 3rd, 3rd-5th gradually, 6th-10th perceptibly increasing in length, 11th once and a half as long as 10th; foveæ of undersurface deep, smooth-walled, almost connected. Prothorax mortar-shaped, much longer than wide, wider than head, truncate at base and apex; anterior two-thirds strongly convex; base with a deep and wide impression, no trace of one at apex.

Elytra about as long as head and prothorax combined, about one and a half times as long as the width at base, each feebly separately rounded (almost truncate), shoulders very feebly rounded. Length to apex of elytra $2\frac{2}{3}$, of abdomen $5\frac{1}{3}$; width 1 mm.

Hab.—Forest Reefs, N.S.W.

A very distinct species, unlike any other known to me; it should perhaps constitute the type of a new genus.

CARPURUS FASCIIPENNIS, Fairm., Mast. Cat. Sp. No. 3426.

This is a somewhat common species in Northern Queensland. The elytral fascia is subject to considerable variation; some specimens have it occupying almost the entire surface, in others it is small, appearing as a dark sutural macula, and in others again it is entirely obsolete. Some specimens are twice as large as others.

CARPURUS ANGUSTATUS, n.sp.

♀. Very narrow, parallel-sided, depressed, feebly shining. Black; first three antennal joints beneath, palpi (except apical joint), a semicircle at base of undersurface of head, and prothorax, red; elytra dark green (in some lights with an obscure purplish reflection); base of coxæ diluted with red. Covered all over with long blackish hair, and—except on prothorax—with short pale pubescence. Head densely—especially at sides—and minutely punctate; prothorax sparsely and obsoletely, the elytra densely, not very strongly, and somewhat rugosely punctate; sides of meso- and metasternum distinctly but minutely, the abdomen very minutely punctate.

Head longer than wide; eyes small, moderately prominent; a depression on each side forming an oblique ridge behind the base of the antennæ, a very shallow impression on the disk (from behind appearing as a small fovea); antennæ slender, almost reaching apex of elytra, joints cylindrical, 1st fully as long as 2nd-3rd combined, 2nd distinctly shorter than 3rd, 3rd-10th gradually increasing in length, 11th acuminate, scarcely one and a half times as long as 10th; base and sides feebly corrugated; foveæ of

undersurface deep, their sides slightly wrinkled. Prothorax strongly rounded, decidedly longer than wide, wider than head; a feeble impression at base, and a still feebler interrupted one at apex; base narrowly margined and feebly sinuate. Elytra gradually dilating towards apex, each feebly separately rounded. Length to apex of elytra $3\frac{1}{2}$, of abdomen $6\frac{3}{4}$; width $1\frac{1}{4}$ mm.

Hab.—Tamworth.

A very narrow species, in colour strongly resembling *C. cyanopterus*, but the width of that species at once separates them.

CARPHURUS ALTERNIVENTRIS, Fairm., Mast. Cat. Sp. No. 3412.

I have a pair (obtained *in copula*) of this species from the Tweed River. The male has the elytra concolorous, whilst in the female they are diluted with red along the base and basal margin; the head in the latter is without markings, while in the former there is a distinct black blotch connecting the eyes.

CARPHURUS BASIVENTRIS, n.sp.

♀. Elongate, shining, depressed. Head, basal joint of antennæ and undersurface of two following, prothorax, extreme tip of femora, tibiæ, and basal joint of tarsi, reddish-testaceous; elytra very dark purple; abdomen with the basal segment, apex of second, apical, and base of penultimate, diluted with red. Above and the legs covered with long black hair, densest and shortest on elytra; sterna with very indistinct pubescence. Head rather densely, irregularly and minutely, prothorax sparsely and minutely punctate; elytra densely and strongly punctate, at the base less strongly than elsewhere; undersurface very indistinctly punctate.

Head much longer than wide; eyes small, prominent; a broad and very shallow depression on each side between eyes; mandibles prominent; antennæ scarcely passing base of prothorax, the joints flat, 1st slightly longer than 2nd-3rd combined, 2nd scarcely the length of 3rd, 3rd-10th subequal, 4th-10th serrate inwardly, 11th not one and a half times as long as 10th; corrugated at base, sides and undersurface; foveæ small, open behind, the space behind them distinctly corrugated. Prothorax a trifle longer than wide,

scarcely if at all wider than head, apex strongly rounded, base truncate and narrowly margined its entire length; a broad shallow impression at base and traces of another at apex. Elytra almost parallel-sided, each feebly separately rounded. Length to apex of elytra $4\frac{1}{2}$, of abdomen 7; width $1\frac{1}{2}$ mm.

Hab.—Como, near Sydney.

Very similar in shape to *C. alterniventris* and, except for the ventral segments, similar in colour; there are several other feeble distinctions.

CARPURUS LONGICOLLIS, n.sp.

♂. Elongate, shining, depressed. Black; prothorax with a faint purplish reflection, head (except eyes, apex and cutting edges of mandibles, and a brownish blotch on the undersurface), three first joints of antennæ, prothorax, and two apical segments of abdomen, red. Covered all over—sparsest on head, densest towards apex of abdomen—with long blackish hairs; elytra and sterna at the sides with obscure, sparse, pale and rather short pubescence. Head and prothorax with sparse minute punctures; elytra densely, minutely and obsoletely punctate; undersurface indistinctly punctate.

Head much longer than wide; eyes small, prominent; the width across them much greater than at base; a shallow depression on each side behind the antennæ; mandibles rather prominent; antennæ rather flat, passing intermediate coxæ; 1st joint slender, arcuate, a trifle longer than 2nd-3rd combined, 2nd subglobose, not quite the length of 3rd, 3rd-10th broad, subequal, 11th very little longer than and not quite the length of 10th; feebly corrugated at base, sides and undersurface; foveæ rather small and rough-walled. Prothorax much longer than wide, as long as head, and at its widest slightly more than head across eyes, widest near apex, angles rounded; a distinct and rather deep impression at base, and a shallower interrupted one at apex; base narrowly margined. Elytra rather strongly dilating towards apex, not more than one and a quarter times as long as the width at apex, each obliquely truncate. Anterior tarsi with basal joint narrow,

as long as three following combined. Length to apex of elytra $3\frac{3}{4}$, of abdomen $5\frac{3}{4}$; width $1\frac{1}{2}$ mm.

♀. Differs in being somewhat dingier, with slenderer antennæ and narrower elytra.

Hab.—Gosford, Sydney, Galston.

Very similar in colour to the preceding, differing in having narrower ventral segments, and in the colour of the two apical ones; it is besides much smaller in size.

CARPHURUS LATIPENNIS, n.sp.

♂. Rather broad, slightly convex, shining. Head black; muzzle testaceous, antennæ black, four basal joints and undersurface of fifth testaceous; prothorax reddish-testaceous; scutellum black; elytra dark coppery green; abdominal segments black, narrowly margined—except apical—with testaceous; legs testaceous, four posterior coxæ and trochantins blackish, femora with more or less black, the intermediate almost encircled near apex. Covered all over—densest on abdomen—with long blackish hair, elytra and sterna in addition with rather short whitish pubescence. Head, prothorax and scutellum sparsely and minutely, elytra densely, equally and rugosely punctate; flanks of meso- and metasternum distinctly but minutely, abdomen very minutely punctate.

Head large, strongly transverse (excluding the mandibles); eyes large, not at all prominent, the sides behind them almost parallel; a semicircular impression between the eyes, the horns of which terminate close to the clypeus and bases of antennæ; near the base a very shallow impression (invisible from some directions); antennæ slender, reaching intermediate coxæ, joints subcylindric, gradually narrowing, 1st as long as 2nd-3rd combined, 2nd not as long as 3rd, 3rd-7th subequal, 8th-11th perceptibly increasing in length; undersurface of head faintly corrugated; two small elongate foveæ in the middle, the space between them distinctly corrugated. Prothorax slightly longer than wide, subquadrate, angles feebly rounded, wider than head across eyes; a shallow irregular impression at base, traces of another at apex; apex distinctly emarginate, base feebly margined and very feebly

sinuate. Elytra subparallel for a third of their length, then dilating towards apex, each feebly rounded towards suture—stronger outwardly. Tibiæ with blackish setæ at their apices; anterior tarsi with basal joint as long as three following combined, and with a black comb inwardly. Length to apex of elytra 6, of abdomen $9\frac{1}{2}$; width $2\frac{3}{4}$ mm.

Hab.—Forest Reefs.

I have another specimen—also a male—which has the anterior edge of prothorax entire, but I can find no other difference.

CARPURUS TESTACEIPES, n.sp.

♂. Elongate, shining, depressed. Head, prothorax and legs clear testaceous; part of the 1st joint of anterior tarsi and posterior trochantins blackish; elytra blackish, with a coppery-green reflection; scutellum, meso- and metasternum black; abdomen black, the basal segments margined; apical half of the antepenultimate, and the two apical, red. Covered all over—sparsest on head and sterna—with long blackish hair, a few long hairs at base of 1st antennal joint; elytra with rather dense whitish pubescence, very sparse on meso- and metasternum. Head and prothorax with sparse minute punctures; on the elytra they are stronger, denser and somewhat rugose; flanks of meso- and metasternum minutely, the abdominal segments very minutely punctate.

Head with feeble corrugations at base and sides, longer than wide; eyes small, not very prominent; antennæ rather thick, passing intermediate coxæ, 1st joint large, thick, feebly emarginate on its upper and slightly inflated on its lower edge, as long as 2nd-4th combined, 2nd equal in length to 4th, and slightly longer than 3rd, 6th-11th perceptibly increasing in length, 6th-8th rather broad, 9th-11th almost cylindric; a depression on each side behind antennæ, feebly connected posteriorly, a low broad ridge—behind which is a small fovea—separating them; undersurface with two shallow transverse impressions, the longest extending between eyes, the other a short distance behind it. Prothorax strongly rounded, about as long as wide, as wide as head; a broad

shallow impression at base, and a shallow interrupted one at apex; base narrowly margined. Elytra almost parallel-sided, each separately rounded. Anterior tarsi with basal joint as long as the three following combined, and having a black comb inwardly. Length to apex of elytra 4, of abdomen $6\frac{1}{2}$; width $1\frac{2}{3}$ mm.

Hab.—Forest Reefs.

Possibly the male of *C. cyanipennis*, of which I have seen but females (five specimens). The antennæ entirely testaceous, and the very large and abnormally shaped basal joint render this species peculiarly distinct.

CARPURUS LEPIDUS, n.sp.

♂. Elongate, shining, depressed. Head, two basal joints of antennæ, prothorax, base of elytra, anterior legs (apex of tibiæ and tarsi infuscate), and intermediate coxæ, testaceous; apical three-fifths of elytra purplish-black, the basal portion a little paler than prothorax; meso- and metasternum black; abdomen testaceous, the two apical segments black; intermediate trochantins and knees, posterior trochantins and basal half of tibiæ, diluted with testaceous. Covered all over with long thin blackish hair (sparsist on head, prothorax and elytra); elytra and sides of meso- and metasternum—to a less extent—with sparse, short, pale pubescence. Head and prothorax sparsely and minutely punctate, the elytra very densely and rather minutely; flanks of meso- and metasternum with minute, the abdomen with very minute punctures.

Head longer than wide; eyes moderately large, prominent, between them very shallow irregular impressions (from in front appearing to be separated by a trident-shaped elevation); antennæ scarcely reaching posterior coxæ, 1st joint scarcely as long as 2nd-3rd combined, 2nd shorter than 3rd, 3rd-5th triangular, to the 10th becoming subpectinate, 11th slightly longer than the inner edge of 10th; sides very feebly corrugated; foveæ of undersurface small, smooth, connected posteriorly. Prothorax rounded, much longer than wide, the width of head (excluding eyes); a very shallow interrupted impression at both base and apex; base narrowly margined. Elytra gradually widening to apex, each

separately rounded. Anterior tarsi with basal joint thick, longer than three following combined, and having a black comb inwardly. Length to apex of elytra 4, width $1\frac{1}{2}$ mm.

Hab.—Galston.

Differs from *C. scapulatus* in having the head concolorous, the testaceous marking of the elytra much larger, and by its differently coloured legs. My unique specimen has the abdomen considerably shrunken.

CARPHURUS PICTIPES, n.sp.

♀. Elongate, shining, depressed. Black; muzzle, undersurface of first three antennal joints, prothorax, anterior coxæ, knees, half of posterior tibiæ, and basal joint of tarsi, testaceous. Covered all over—sparsest on middle of meso-, metasternum and head—with short pale pubescence; above with blackish hair, sparsest on prothorax, longest on abdomen. Head and prothorax sparsely and minutely, elytra very densely, minutely and obsoletely punctate; flanks of meso- and metasternum minutely, abdomen very minutely punctate.

Head scarcely longer than wide; eyes rather large, not very prominent, a foveate impression on each side between them (from some directions appearing as two, in others as four longitudinal foveæ); antennæ reaching posterior coxæ, 1st joint scarcely as long as 2nd-3rd combined, 2nd decidedly shorter than 3rd, 3rd-10th subequal in length, 4th-5th triangular, 6th-10th subpectinate, 11th elongate-ovate, as long as the inner edge of 10th; sides and undersurface corrugated; foveæ rather large, round, rough-walled, open behind. Prothorax strongly rounded, longer than wide, not the width of head; an extremely shallow and very indistinct impression at base, a stronger interrupted one at apex; base very feebly margined, and feebly sinuate. Elytra one and a half times as long as head and prothorax combined, sides gradually widening to apex, each feebly separately rounded. Length to apex of elytra $4\frac{1}{3}$, of abdomen 6; width $1\frac{3}{5}$ mm.

Hab.—Como, near Sydney.

Close to *C. rhagonychinus*, differing in the colour of its legs and by having a broader head and prothorax.

CARPHURUS APICIVENTRIS, n.sp.

♂. Black; elytra with an obscure purplish reflection; muzzle, two basal joints of antennæ and undersurface of third, prothorax, 3rd and 4th abdominal segments, anterior legs, and intermediate coxæ, clear reddish-testaceous; scutellum dull red; basal half of four posterior tibiæ impure testaceous, apical half and tarsi piceous. Sparsely clothed with longish brown hair—densest on abdomen and elytra; flanks of meso- and metasternum with short, pale pubescence. Head and prothorax sparsely and minutely, elytra very densely and not very minutely punctate; sides of meso- and metasternum with minute, abdomen with very minute punctures.

Head transverse; eyes large, prominent, between them very shallow irregular impressions (from in front appearing to be separated by a trident-shaped elevation); from in front there appears to be a small transverse fovea between the eyes, near the base a very shallow transverse impression; antennæ scarcely reaching posterior coxæ, 1st joint scarcely as long as 2nd-3rd combined, 2nd subglobular, decidedly shorter than 3rd, 3rd-4th triangular, 5th-10th subpectinate, 11th fully as long as the inner edge of 10th; undersurface of head with a shallow transverse impression. Prothorax decidedly longer than wide, as wide as head at base of eyes, angles rounded; a feeble impression at base and traces of a still feebler one at apex; base narrowly margined. Elytra gradually widening to apex, each rather strongly rounded. Anterior tarsi with basal joint thick, longer than the following joints combined, and having a black comb inwardly. Length to apex of elytra $4\frac{1}{2}$, of abdomen $6\frac{1}{2}$; width $1\frac{1}{3}$ mm.

Hab.—Galston.

Of the shape of *C. rhagonychinus* and the preceding, but the red ventral segments will at once distinguish it from either of them.

var. DUBIUS.

Differs from the above in having the head almost concolorous, having only a small transverse spot extending from the eyes

and not reaching the middle, the two apical segments only of the abdomen black, and all the legs testaceous, tarsi except basal joints black.

As upon a careful comparison of my two specimens—both males—I can find absolutely no difference in shape, I have considered it advisable to describe the most strongly marked specimen as a species, ranking the other as a variety. I captured them at the same time.

CARPHURUS BIFOVEATUS, n.sp.

♂. Elongate, shining, depressed. Head black; undersurface of basal joint of antennæ and almost the entire second reddish; palpi obscure red; prothorax red; elytra dark violet-blue, meso- and metasternum black; abdominal segments black—the first almost entirely, and the others except apical margined with red. Moderately densely clothed all over with long blackish hairs. Head and prothorax sparsely and minutely punctate, elytra with minute and almost obliterated punctures, apex and sides of meso- and sides of metasternum minutely but distinctly punctate, the abdomen very minutely.

Head about as long as wide; a longitudinal excavation on each side near the eyes (from some directions appearing as foveæ); antennæ short, scarcely passing intermediate coxæ, 1st joint large, as long as 2nd-3rd combined, 2nd short, globular, 3rd obconic, 4th-10th subpectinate, 11th as long as the inner length of 10th; feebly corrugated; foveæ of undersurface large, rough-walled, approximate. Prothorax strongly rounded, a little longer than wide, the width of head across eyes; a shallow transverse impression at base, and a still shallower one at apex. Elytra feebly dilating towards apex, each feebly separately rounded. Anterior tarsi with basal joint rather wide, and fully as long as claw joint. Length to apex of elytra 3, of abdomen $5\frac{3}{4}$; width 1 mm.

Hab.—Galston (Mr. D. Dumbrell).

A distinct and very pretty little species.

C. *CYANIPENNIS*, Macl.; Mast. Cat. Sp. No. 3422.

Hab.—Tamworth, Whitton (Lea). S. Australia (Macleay Museum).

C. ELONGATUS, Macl.; Mast. Cat. Sp. No. 3424.

Hab.—Tweed River, Sydney, Forest Reefs, Whitton.

C. PALLIDIPENNIS, Macl.; Mast. Cat. Sp. No. 3430.

Hab.—Rockhampton (Macleay Museum).

C. APICALIS, Macl.; Mast. Cat. Sp. No. 3413.

Hab.—Richmond River.

C. SCAPULATUS, Fairm.; Mast. Cat. Sp. No. 3433.

Hab.—Galston (Dumbrell).

C. MARGINIVENTRIS, Fairm.; Mast. Cat. Sp. No. 3428.

Hab.—Gosford.

C. RHAGONYCHINUS, Fairm.; Mast. Cat. Sp. No. 3432.

Hab.—Sydney, Galston.

C. FACIALIS, Fairm.; Mast. Cat. Sp. No. 3425

Hab.—Sydney.

C. ARMIPENNIS, Fairm.; Mast. Cat. Sp. No. 3414.

Hab.—N. Queensland (Macleay Museum).

C. BASIPENNIS, Fairm.; Mast. Cat. Sp. No. 3417.

Hab.—S. Australia (Macleay Museum).

C. CYANOPTERUS, Bohem.; Mast. Cat. Sp. No. 3442.

Hab.—Blackheath (Masters).

I append a tabulation of all the species known to me, which, though artificial, and largely dependent on colour, may prove to be useful:—

Elytra armed in the male.

Armature near base directed backwards *armipennis*, Fairm.

Armature near apex directed forwards.

Sharp-pointed *crisatifrons*, Fairm.

Globular..... *Blackburni*, n.sp.

Elytra unarmed in the male.

Antennæ simple or at the most slightly serrate internally.

Head carinate *carinaticeps*, n.sp.

Head with a small tubercle in the middle... *impunctatus*, n.sp.

Head with various impressions in front.

Scutellum testaceous or reddish.

Two intermediate segments of abdomen

black *alterniventris*, Fairm.

Apical segments only black *apicalis*, MacI.

All the segments clouded with black at their bases *fasciipennis*, Fairm.

Scutellum black.

Prothorax with blackish markings at the sides.

Posterior tibiæ black *marginiventris*, Fairm.

All the tibiæ testaceous.

Elytra immaculate *pallidipennis*, MacI.

Apical half (or third) of elytra black *elongatus*, MacI.

Prothorax immaculate.

Legs black.

Abdomen black.

Large and moderately robust *cyanopterus*, Bohem

Narrow and elongate.. *angustatus*, n.sp.

Apex of abdomen red..... *longicollis*, n.sp.

Legs variously coloured.

Head reddish..... *basiventris*, n.sp.

Head black *basipennis*, Fairm.

Muzzle reddish.

Large, robust elytra greenish, abdomen narrowly bordered... *latipennis*, n.sp.

Smaller, elytra greenish, abdomen broadly bordered *cervicalis*, Germ.

Smaller, elytra without a greenish tinge, abdomen unicolorous *facialis*, Fairm.

Legs testaceous.

Antennæ thick, entirely testaceous *testaceipes*, n.sp.

Antennæ rather slender, base only testaceous.. *cyanipennis* MacI.

Antennæ subpectinate.

Abdomen testaceous, apical segments black.

Scutellum black *scapulatus*, Fairm.

Scutellum testaceous or reddish.

Elytra with the base testaceous..... *lepidus*, n.sp.Elytra concolorous..... *apiciventrīs*, n.sp.

Abdomen black.

Legs testaceous..... *rhagonychinus*, Fairm.Legs black, with testaceous markings *pictipes*, n.sp.

Abdomen black, basal segments with more

or less red..... *bifoveatus*, n.sp.

BALANOPHORUS MASTERSI, MacL.; Mast. Cat. Sp. No. 3440.

This species ranges down the entire east coast and for some distance inland; specimens are in the Macleay Museum from Cape York to Melbourne. The male possesses a most peculiar comb; it is situated on the inner edge of the first joint of the anterior tarsi, and consists of about sixty closely set elongate teeth; it commences at the base and is continuous round the apex almost to the outer margin; under a Coddington lens it appears as a black margin, but a moderately low power of the microscope renders it visible. As will be noticed I have described a number of species of *Carphurus* and *Helcogaster* as possessing combs; there is a somewhat similar comb on the intermediate tibiae of a species of *Staphylinidae* in the Collection of the Rev. R. L. King (now in the Sydney Museum).

BALANOPHORUS MACLEAYI, n.sp.

♂. Elongate, shining, subdepressed. Testaceous; apical two-thirds of antennæ, meso-, metasternum, two apical segments of abdomen, four posterior femora and apex of tibiae black; apical two-fifths of elytra dark purple. Head, prothorax, abdomen and legs with sparse blackish hair; elytra and sterna with sparse, short, pale pubescence. Head and prothorax sparsely and minutely, elytra not very densely, minutely, and obsoletely punctate; undersurface almost impunctate.

Head transverse; eyes very large and prominent, their combined width being more than half the total width of head; a

feeble depression on each side—commencing near the middle of the eyes, and terminating slightly in advance of base of antennæ; antennæ passing posterior coxæ, 1st joint as long as 2nd-3rd combined, 2nd scarcely half the length of 3rd, 3rd-10th pectinate, the tooth of 3rd short, about half the length of 4th, 5th-11th very long, all of them with long curved blackish hair; foveæ of undersurface very small, situated in a shallow depression, the space behind them finely but distinctly corrugated. Prothorax much longer than wide, more than the width of head at base of eyes, apex rounded, sides dilated near apex, constricted near base—which is sinuate; a broad shallow impression at base. Scutellum about twice as wide as long. Elytra parallel for a fourth their length, then dilating to apex, each rounded from the suture, and then obliquely truncate. Anterior tarsi with basal joint as long as three following combined, and having a black comb inwardly. Length to apex of elytra 5, of abdomen $7\frac{1}{4}$; width $2\frac{1}{4}$ mm.

♀. Differs in being larger, antennæ subpectinate, head longer than wide, eyes much smaller, less black on elytra, simple anterior tarsi, &c.

Hab.—North-West Australia (Macleay Museum).

A most beautiful species, somewhat resembling, but abundantly distinct from, *B. Mastersi*; the large eyes of the male are a very distinctive feature, whereas in the two sexes of *Mastersi* they are equal; there are besides numerous other differences in colour and shape.

B. JANTHINIPENNIS, Fairm.; Mast. Cat. Sp. No. 3439.

Hab.—Sydney.

P Y T H I D Æ.

TRICHOSALPINGUS ORNATUS, n.sp.

Depressed, derm feebly shining. Testaceous, elytra, legs and antennæ paler than head and prothorax; prothorax with an obscure brownish blotch at the sides; each elytron with an oblique black stripe—gradually increasing in width—commencing on the shoulder, and a little longer than prothorax, its outer apex

equidistant from side and suture; an obscure narrow fascia about the middle, almost obsolete towards the sides, oblique towards the suture; undersurface reddish-brown, with obscure piceous blotches. Above densely clothed with rather long pubescence, a little paler than the derm on which it rests, densest on elytra; sides of sterna pubescent as prothorax; abdominal segments densely clothed with moderately short pubescence. Above very densely and minutely punctate; on prothorax the punctures almost concealed by pubescence; sterna densely and minutely, the abdominal segments very minutely punctate.

Head about as long as wide; eyes rather large, not very prominent; antennæ short, not reaching anterior coxæ. Prothorax very feebly transverse, a little the widest about its middle, where it is fully as wide as head, truncate at base and apex; base feebly margined, an oblique impression from each side of the base. Elytra about two and a half times as long as head and prothorax combined, at the base about once and a third the width of base of prothorax, shoulders rounded, sides widening to beyond the middle. Legs rather short, not very thick. Length $3\frac{4}{5}$, width $1\frac{1}{2}$ mm.

Hab.—Gosford.

TRICHOSALPINGUS PALLIPES, n.sp.

Depressed, derm shining. Testaceous, elytra not much paler than head and prothorax, legs and antennæ decidedly paler than elytra; prothorax with an obscure brownish blotch at the extreme sides; elytra with a moderately large blotch about the middle, moderately sharply defined at its anterior edge, much less so at the posterior; undersurface a little darker than head, without blotches. Above covered with very short pale pubescence, moderately dense on elytra; undersurface extremely minutely pubescent. Above very densely and minutely punctate, punctures most noticeable at base of elytra, becoming feebler towards apex; undersurface very minutely punctate, punctures most visible on pro-, meso- and sides of metasternum.

Head about as long as wide; eyes not very large, prominent; antennæ short, not reaching anterior coxæ. Prothorax quadrate, very little wider in front than behind, not the width of head, truncate at base and apex, base narrowly margined, an oblique impression commencing at each side of the base—where it is distinct—afterwards becoming shallower and obliterated. Elytra about two and a quarter times as long as head and prothorax combined, at the base about one and a half times the width of prothorax at base, shoulders rounded, sides widening to beyond the middle. Legs rather short, not very thick, tarsi slender. Length 3, width $1\frac{1}{3}$ mm.

Hab—Galston (Mr. D. Dumbrell).

Differs from the preceding in being smaller, in having prominent eyes, thinner antennæ, narrower prothorax, with basal impressions more distinct, sparser pubescence, different markings of elytra, paler undersurface and legs, &c. I have but one specimen of each.

TRICHOSALPINGUS LATERALIS, n.sp.

Depressed, shining. Testaceous-brown; elytra—except at sides—a little paler than head and prothorax, undersurface darker than above; sterna and femora stained with piceous. Above clothed with very short pale pubescence; sides of sterna with minute pubescence. Head and prothorax very densely and minutely punctate, on the elytra at the base the punctures are not as dense, but are larger, becoming smaller and obliterated towards apex; undersurface minutely but distinctly punctate, punctures largest on pro-, meso- and sides of metasternum.

Head transverse; eyes rather large, not very prominent; antennæ short, reaching anterior coxæ. Prothorax transverse, slightly wider than head, a little wider in front than behind, angles feebly rounded; base narrowly margined, an impression at the base close to the sides. Elytra about two and a half times as long as head and prothorax combined, at the base not much wider than prothorax at apex, shoulders rounded, sides feebly widening to beyond the middle; a very feeble depression about scutellum

and behind the base. Legs rather short and thick. Length $4\frac{1}{2}$, width $1\frac{1}{2}$ mm.

Hab.—New South Wales (probably from about Sydney).

MELANDRYIDÆ.

ORCHESIA SALTATORIA, n.sp.

Short, robust, convex, shining. Dark castaneous, legs and antennæ slightly paler. Moderately densely clothed all over with short brownish-yellow pubescence, shortest at apex of elytra, longest on prothorax. Feebly transversely punctate-strigose all over.

Head somewhat triangular in shape; antennæ thickening to apex, passing intermediate coxæ, 1st joint one and a half times as long as 2nd, 2nd-3rd subequal, longer than those following, 4th-6th short, subcylindrical, 7th-11th broader, flat, 11th about twice as long as 10th. Prothorax much wider behind than in front; broadly and feebly bisinuate, and with a shallow depression on each side of the base; median line invisible. Scutellum small, broadly transverse. Elytra about two and a half times as long as wide, a very feeble depression on each side of suture, most visible towards apex. Posterior tibiæ short, thick, their spurs stout, almost equal, as long as themselves, and about three-fourths the length of first tarsal joint; tarsi with the basal joint distinctly longer than tibiæ, or the three following joints combined. Length $3\frac{3}{4}$, width $1\frac{1}{2}$ mm.

Hab.—Forest Reefs.

I have nine specimens under examination, in the size of which there is but very little difference. I suppose I must have the sexes, but I cannot distinguish them; the species comes closest to *O. Macleayi*, but its much smaller size, broader form, &c., will easily separate it from that species. All my specimens were taken on tops of posts at dusk; they hopped immediately the hand was brought near them, and in this way I lost many others.

DIRCÆA 4-MACULATA, n.sp.

Elongate, convex, shining. Dark piceous-brown, muzzle, apex of prothorax, apex of elytra, and spurs indistinctly paler; each elytron with two small maculæ—the first and largest situated about a fourth from the base, and midway between side and suture, elliptic or ovate in shape, and very slightly oblique; the second situated about a third from the apex, a little closer to suture than to side, and transversely rounded. Moderately clothed with very short greyish pubescence, a little more densely on abdominal segments than above. Head, prothorax and sterna densely and minutely punctate; elytra at base feebly transversely punctate-strigose; rest of elytra and abdominal segments very minutely punctate.

Head round; antennæ somewhat flattened, reaching to midway between intermediate and posterior coxæ, 1st joint not as long as 2nd-3rd combined, 2nd more than half the length of 3rd, 3rd-10th subequal, 11th not once and a half as long as 10th, 9th-11th slightly concave inwardly. Prothorax subquadrate, base narrowly margined and almost truncate; median line very feebly traceable, a distinct but rather small fovea marking its base. Elytra about four times as long as wide, shoulders rounded, sides parallel to about a third from the apex, traces of a number of costæ on basal half, entirely obsolete on apical. Posterior tibiæ feebly depressed, serrate on their outer edge; spurs very short, not quite equal; basal joint of tarsi twice the length of the following, the two combined as long as tibiæ. Length $4\frac{1}{2}$, width 1 mm.

Hab.—Glen Innes, N.S.W.

I think my specimen is a male, as I have seen others which were considerably larger and broader.

DIRCÆA LIGNIVORA, n.sp.

♀. Elongate, convex, subcylindrical, subopaque. Dark piceous-brown, prothorax with the margins very little paler; elytra with base, margins and suture obscure ferruginous, each with two pale testaceous markings—the first, and smallest, irregularly ovate,

situate at about a third from the base, and midway between side and suture; the second lunulate, situate at about a fourth from apex, not quite touching side or suture; abdominal segments in some lights appearing wholly ferruginous, in others only their apices, basal joints of antennæ, palpi and legs brownish-testaceous. Head, prothorax, basal half of elytra and sterna densely, minutely and transversely punctate-strigose, the shoulders most distinctly; apex of elytra and the abdominal segments minutely punctate. Moderately densely clothed all over with short greyish pubescence, somewhat sericeous on prothorax, scutellum and lower surface.

Head rounded; antennæ slender, cylindrical, reaching about half way between intermediate and posterior coxæ, 1st joint almost as long as 2nd-3rd combined, 2nd not much shorter than 3rd, 3rd-10th very gradually decreasing, 10th-11th equal. Prothorax subquadrate, with the base—except for the slightly produced angles—truncate, base with a very feeble depression, and narrowly margined; median line distinct at base, feebly traceable towards apex. Scutellum transverse, feebly emarginate at apex. Elytra more than three times as long as wide, shoulders feebly rounded, sides very gradually narrowing to near the apex, a narrow depression on each side of the suture, a very feeble depression near shoulders, with feeble traces of striæ. Legs slender, four posterior tibiæ depressed-serrate externally, spurs to the posterior unequal, the longest a little more than one-third the length of the first tarsal joint, the shortest about a fourth; intermediate and anterior spurs very short; posterior tarsi with the basal joint almost as long as the following combined, the two basal as long as tibiæ. Length $10\frac{1}{2}$, width $2\frac{1}{2}$ mm.

♂. Differs in being smaller and narrower. Length 3, width $\frac{3}{5}$ mm.

Hab.—Donnybrook, W.A.

Several trees were riddled by this species, of which I could have taken hundreds; the markings are constant, but the size is extremely variable (I have given the extremes); the larvæ are largely destroyed by two species of Hymenopterous parasites.

P E D I L I D Æ.

MACRATRIA INTERMEDIA, n.sp.

♂. Narrow, subparallel, subdepressed, shining. Head, prothorax and undersurface dark, or brownish-red; elytra dark red, becoming piceous at apex; legs and antennæ testaceous, apical joint of antennæ darker; abdominal segments paler than sterna. Above densely clothed with silky yellowish pubescence, longest on elytra (when seen from behind apparently in lines); on the undersurface the pubescence is much shorter and denser; the legs are somewhat densely pubescent. Head minutely punctate, prothorax more densely and strongly; elytra seriate-punctate, the punctures shallow, interstices minutely punctate; undersurface—except the flanks of the mesosternum which are distinctly—minutely punctate.

Head longer than wide, almost truncate at base; eyes large; antennæ slender, reaching intermediate coxæ, 1st joint about as long as 2nd-3rd combined, 2nd as long as and thicker than 3rd, 3rd slightly longer than 4th, 4th-8th subequal, 9th-10th slightly longer, 11th as long as 7th-10th combined. Prothorax much longer than wide, and wider than the head, widest near the apex; apex rounded, base margined and truncate. Elytra very gradually narrowing to near the apex, shoulders moderately rounded, each elytron separately rounded at apex; suture slightly raised except at base, where it is feebly depressed. Metasternum deeply sulcate, apical segment of abdomen shallowly emarginate at apex. Legs long; femora thickened, the anterior their entire length, intermediate for the apical two-thirds, posterior for the apical half; tibiæ straight, longer than tarsi, minutely spurred at apices, posterior spurs the longest; basal joint of posterior tarsi nearly twice as long as the following combined, the four anterior little more than half as long. Length $3\frac{1}{2}$, width $\frac{3}{4}$ mm.

♀. Differs in being somewhat larger ($3\frac{3}{4}$ mm.) and darker, in having the piceous colour more advanced on the elytra (leaving only the base dark red), apical joint of antennæ only as long as

the two preceding combined, apical segment of abdomen entire, and the spurs to posterior tibiæ shorter.

Hab.—Cairns (Macleay Museum).

Differs from *M. aberrans*, in being narrower, and without trace of median line; in size it is intermediate between that species and *M. australis*.

MACRATRIA ANALIS, n.sp.

♂. Narrow, subparallel, subdepressed, shining. Reddish-brown; head lighter in colour than prothorax or elytra, the latter with a piceous tinge about scutellum and suture; antennæ testaceous, apex slightly infusate; sterna a little darker than prothorax: coxæ coloured as prosternum, legs testaceous-red, four anterior femora and apical segment of abdomen pale testaceous. Above clothed with yellowish silky pubescence, shorter and paler beneath. Head minutely, prothorax densely and a little more strongly punctate; elytra punctate-striate, the punctures irregular towards suture, more distinct towards sides, and obsolete on apical third; sterna minutely, abdominal segments very minutely punctate.

Head not much longer than wide, base feebly rounded; eyes large, not prominent; antennæ slender, inserted close to eyes, reaching intermediate coxæ, slightly thickening towards apex, 11th joint a little longer than 9th-10th combined and feebly constricted in the middle. Prothorax longer than wide, near apex wider than head, at base wider than head at base of eyes; apex strongly rounded; sides constricted near base, base truncate and narrowly margined; median line traceable on basal two-thirds. Scutellum transverse, truncate at apex. Elytra wider than prothorax, feebly diminishing towards apex, shoulders rounded, suture feebly depressed near base, and feebly elevated near apex. Metasternum sulcate on apical two-thirds, deeply on apical third. Apical segment of abdomen feebly depressed in the middle, its sides at the apex feebly emarginate—allowing the tips of two small discs to appear. Legs long and rather thick; femora thick, the four posterior only on their apical half; tibiæ straight, minutely spurred at apex; basal joint of posterior tarsi much

longer than those following combined. Length $3\frac{3}{4}$, width $\frac{4}{5}$ mm.

Hab.—Tamworth.

This species comes closest to the preceding, from which it may be distinguished by its larger size, broader prothorax—with more deeply constricted base—thicker antennæ, shorter and paler pubescence, feebler elytral punctuation, and more distinct scutellum.

ANTHICIDÆ.

FORMICOMUS ELEGANS, n.sp.

Narrow, elongate, depressed, subopaque above, shining on undersurface. Brown; undersurface, coxæ, base of femora, four anterior tibiæ and tarsi, and antennæ pale; elytra with two transverse white fasciæ—the first near the base and parallel, except for a triangular encroachment at the suture behind, the posterior close to apex, straight in front, narrowing to suture from behind. Covered all over with very short, rather pale pubescence, with a few short erect hairs on elytra. Covered all over with extremely minute punctures, densest on head.

Head longer than wide, scarcely obovate; eyes small, prominent, placed slightly before the exact middle; antennæ slender, reaching anterior fascia, inserted considerably in front of eyes, 1st joint not as long as 2nd-3rd combined, 2nd not much shorter than 3rd, 4th-10th slightly decreasing in length and as gradually thickening, 11th not one and a half times as long as 10th. Prothorax not twice as long and scarcely as deep as wide; strongly rounded in front, constricted near the base, base narrowly margined: an almost obliterated tubercle on each side. Elytra scarcely longer than head and prothorax combined, slightly widest at the middle, base rounded as apex; without impressions. Legs—especially the posterior—very long and thin, femora scarcely thickened, tibiæ straight, longer than tarsi; 1st joint of posterior tarsi scarcely as long as the following combined, 2nd as long as 4th (including claws), 1st joint of intermediate as long as 2nd-3rd combined, of the anterior shorter. Length 3, width $\frac{3}{4}$ mm.

Hab.—North-West Australia (Macleay Museum).

The feature of this species is its very long posterior legs, which are longer than the entire body. From *F. australis*, which it somewhat resembles, it differs in being longer, slenderer, lighter in colour and more opaque, differently shaped prothorax, longer legs, and in numerous other particulars.

ANTHICUS RECTIFASCIATUS, n.sp.

Depressed, shining. Head, prothorax and undersurface red, elytra testaceous, base somewhat darker, a broad median band—very feebly connected with apex along sides and suture—black; legs, palpi and antennæ testaceous, the latter becoming darker towards apex; abdominal segments clouded with piceous at the sides. Above not very densely clothed with yellowish suberect pubescence, on the undersurface the pubescence is shorter and denser. Head densely punctate, prothorax more densely and minutely, elytra strongly punctate at the base, the punctures becoming feebler towards apex; undersurface minutely punctate.

Head transverse, base truncate; eyes large, coarsely faceted; antennæ slender, reaching median fascia, 1st joint slightly longer than 2nd-3rd combined, 2nd short, 3rd longer, 4th-10th gradually decreasing in length, 11th longer than 10th and as long as 8th. Prothorax slightly longer, and at its widest not quite as wide as the base of head, subcordate, longer than wide, rounded in front, truncate and margined behind. Elytra nearly twice as long as head and prothorax combined, much wider than prothorax at base, and wider than head across eyes; shoulders slightly rounded, sides subparallel to near the apex; suture feebly depressed at base. Legs slender, femora slightly thickened, tibiæ straight, longer than tarsi, minutely spurred at their apices. Length $3\frac{1}{2}$, width $1\frac{1}{3}$ mm.

Hab.—Fitzroy Island, Queensland (Macleay Museum).

ANTHICUS SCUTELLATUS, n.sp.

Of the form of *A. brevicollis*; subdepressed, shining—especially the head and undersurface. Reddish-testaceous, elytra paler than prothorax, which is paler than head; sides of abdominal segments

obscure; eyes black; tip of mandibles piceous. Above not very densely clothed with yellowish decumbent pubescence, with a few erect short hairs—a few of which project laterally on prothorax—densest on prothorax, sparsest on head; on the undersurface the pubescence is sparser, and—except on abdominal segments—longer than above. Head distinctly but not very densely punctate; prothorax densely, elytra shallowly and not very densely punctate; sterna scarcely distinctly, the abdominal segments very feebly punctate.

Head short, transverse, base feebly emarginate; eyes large, occupying more than half the side of head between antennæ and base; mandibles prominent; antennæ short, scarcely reaching base of prothorax, 1st joint as long as 2nd-3rd combined, 2nd short, 3rd-4th narrowest, 4th-10th gradually decreasing in length, 11th about once and a quarter as long as 10th, acuminate at apex, 2nd and 6th-10th globular. Prothorax subcordate, transverse, broader and longer than head, sides rounded; base constricted and narrowly margined, middle of the apex narrowly produced and margined. Scutellum small, triangular, distinct. Elytra almost twice as long as head and prothorax combined, and about twice as long as the width at base, shoulders feebly rounded, the base near them very feebly impressed. Legs short; femora thickened; tibiæ straight, a minute spur at their apices. Length $3\frac{1}{3}$, width $1\frac{1}{2}$ mm.

Hab.—North-west Australia (Macleay Museum).

My specimen is damaged, all the tarsi with the exception of one of the anterior and an antenna being missing. It may be distinguished from *A. luridus* by its longer pubescence, &c.

ANTHICUS INGLORIUS, n.sp.

♂. Shaped somewhat as *A. brevicollis*; subdepressed, shining. Prothorax reddish-testaceous, head darker, elytra paler; undersurface brownish-testaceous, antennæ, palpi, anterior legs, four posterior tibiæ and tarsi, and base of femora paler; eyes black; tip of mandibles piceous. Above sparsely clothed with short pale pubescence, with rather long hairs projecting laterally from

prothorax and elytra; head almost glabrous; undersurface with sparse straggling pubescence. Above sparsely and minutely punctate, punctures sparsest and rather strong on head; not much feebler at apex than at base of elytra; undersurface almost impunctate.

Head scarcely transverse, base feebly emarginate; eyes large, occupying about half the side of head between antennæ and base; antennæ short, reaching base of prothorax, the joints as in *A. scutellatus*, a shallow depression on each side in front. Prothorax transverse, very slightly broader and longer than head, broadest near apex, narrowing—but not suddenly—to base; base margined, middle of apex feebly produced and margined. Scutellum small, transverse, apex rounded. Elytra not twice as long as head and prothorax combined ($2\frac{1}{2}$ - $1\frac{1}{3}$ mm.), about twice as long as wide, shoulders feebly rounded, the base near them feebly impressed. Legs rather short, femora feebly thickened, tibiæ straight, the anterior slightly curved at apex, posterior spurred at apex. Length 4, width $1\frac{1}{2}$ mm.

♀. Differs in being paler beneath, and by having concolorous legs.

Hab.—Darling River (Macleay Museum).

May be distinguished from *A. scutellatus* by its more elongate form, somewhat differently shaped prothorax, long legs, shinier derm, sparser pubescence, &c.

ANTHICUS TRIANGULARIS, n.sp.

Of the form of *A. brevicollis*; depressed, shining. Head, prothorax and undersurface red; elytra testaceous, a large subtriangular macula—which is somewhat variable in size—on each side at the middle, and the apex piceous-brown, an obscure red triangle about the scutellum; abdominal segments stained with brown; legs and antennæ testaceous, the latter becoming brown towards apex. Head and prothorax almost glabrous, elytra sparsely pubescent, undersurface with shorter and denser pubescence. Above not strongly punctured, the punctures sparsest and broadest on head, denser and not much feebler on prothorax,

denser at base and shallowest at apex of elytra; undersurface minutely punctate.

Head longer than the width at base, and—excluding the eyes—triangular in shape; eyes large, prominent, coarsely faceted, placed midway between antennæ and base; antennæ reaching beyond base of elytra, 1st joint slightly longer than 2nd-3rd combined, 2nd-10th equal in thickness, 2nd not much shorter than 3rd, 4th-10th gradually decreasing, 11th slightly narrower than 10th, and nearly as long as 9th-10th combined. Prothorax subcordate, feebly transverse, as broad as, and slightly longer than head, widest in front, constricted behind, base margined. Scutellum triangular, distinct. Elytra about one and a half times as long as head and prothorax combined, shoulders feebly rounded, the base near them feebly impressed, sides feebly widening to about the middle, apex broadly rounded. Legs rather short; femora moderately thickened; posterior tibiæ feebly bent, spurred at apex; tarsi shorter than tibiæ. Length $2\frac{1}{2}$, width $\frac{3}{4}$ mm.

Hab—North-West Australia (Macleay Museum).

May be distinguished from *A. brevicollis* by its flatter form, larger head, sparser pubescence, &c.; *A. Wollastoni* is a species with somewhat similarly marked elytra, but otherwise very different. I have recently taken two specimens at Perth which differ from the types in being darker, in having a complete median fascia, the dark marking at apex of elytra larger, the scutellar marking darker and continued on to shoulders; the pubescence also is denser; as, however, they belong to a group the members of which are very variable I have not thought it advisable to describe them as distinct.

ANTHICUS LEMODIODES, n.sp.

Elongate, subdepressed, shining. Head and prothorax chocolate-brown; elytra reddish-testaceous, a moderately broad piceous fascia, interrupted at suture, across the middle; lower surface paler than prothorax; legs paler than elytra. Above not densely clothed with short pubescence, with longer hairs at the sides; undersurface with minute pubescence. Head and prothorax

rather shallowly punctate; the elytra densely, strongly and serially punctate; sterna densely and strongly, abdominal segments not very minutely punctate.

Head rather small, transverse; eyes moderately large, placed behind the middle; antennæ not very slender, subequal in width, reaching apex of intermediate coxæ, 1st joint nearly as long as 2nd-3rd combined, 2nd-3rd equal, 11th not as long as 9th-10th combined. Prothorax longer than wide, wider than head, transversely globose in front, deeply constricted near base, base truncate; a tubercle on each side at base; median line distinct, becoming feeble near apex, and having a small fovea near tubercles. Scutellum extremely small. Elytra not one and a half times as long as head and prothorax combined, not much wider than anterior portion of the latter, shoulders feebly rounded, sides parallel to near apex; a feeble impression on each side between suture and shoulders; suture very feebly raised near apex. Legs rather short and thick; four posterior femora arcuate; tibiæ rather short, posterior feebly bent. Length $2\frac{4}{5}$, width 1 mm.

Hab.—Forest Reefs; crawling over fences at night time.

ANTHICUS CANCELLATUS, n.sp.

Elongate, subdepressed, shining. Reddish-testaceous; head and prothorax darker than elytra, the latter with a small obscure piceous blotch about the middle; lower surface a little paler than elytra; legs and palpi pale testaceous. Above—except head—densely clothed with rather long pubescence, longest on elytra: on the undersurface the pubescence is short. Head and prothorax densely and obsoletely, elytra densely and strongly, gullet coarsely, sterna and abdominal segments not very strongly punctate.

Head rather small, transverse; eyes moderately large, placed behind the middle; antennæ rather slender, passing intermediate coxæ, 1st joint nearly as long as 2nd-3rd combined, 2nd decidedly shorter than 3rd, 11th a little longer than 9th-10th combined. Prothorax not much longer than wide, wider than head, transversely globose in front, deeply constricted near base, base truncate; traces of a tubercle on each side at base; median

line very shallow and indistinct, obsolete towards apex. Scutellum small, transverse, moderately distinct. Elytra about once and a third as long as head and prothorax combined, not much wider than anterior portion of latter, sides almost parallel, apex almost truncate, a feeble depression on each side of suture towards apex. Femora thick, tibiae straight. Length $2\frac{2}{3}$, width 1 mm.

Hab.—Forest Reefs; on fences at dusk.

The above somewhat resembles the preceding and the following species; from the former it may be distinguished by its colour and puncturation being a little different, by its thinner legs and less plainly marked median line; from the latter by being a little more elongate, a little less convex, median line distinct, thicker legs, &c.

ANTHICUS PIGNERATOR, n.sp.

Not very elongate, slightly convex, shining. Obscure reddish-testaceous, elytra very little paler than head and prothorax; lower surface concolorous with elytra, and darker than legs. Pubescence as in the preceding. Head shallowly, prothorax very densely and shallowly, elytra densely and strongly, sterna densely, abdominal segments minutely, punctate.

Head rather small, transverse; eyes moderately large, placed close to base; antennae moderately slender, passing intermediate coxae, the width separating them equal to the distance to base of eyes, 1st joint about once and a half longer than 2nd, 2nd a little shorter and thicker than 3rd, 11th about as long as 9th-10th combined. Prothorax not much longer than wide, wider than head, transversely globose in front, constricted near base, base truncate; a transverse impression at base and a shallow circular one on each side of the middle; no median line. Scutellum indistinct. Elytra about once and a third as long as head and prothorax combined, not much wider than anterior portion of latter, shoulders feebly rounded, sides subparallel to near apex, a feeble depression on each side of suture about middle. Legs rather slender; femora not very thick; posterior tibiae very feebly bent inwardly. Length $2\frac{1}{4}$, width $\frac{4}{5}$ mm.

Hab.—Forest Reefs; on a fence at dusk.

ANTHICUS INORNATUS, n.sp.

Elongate, narrow, feebly shining. Head dark reddish-brown, prothorax and elytra dark brownish-red, undersurface somewhat paler, legs and antennæ testaceous-red. Elytra and abdomen not very densely covered with short pale pubescence; rest of body very sparsely clothed. Head extremely densely and somewhat rugosely punctate; prothorax, sterna and basal segment of abdomen very densely and not minutely punctate; elytra densely punctate, punctures becoming feebler towards apex, abdominal segments—except basal—minutely, femora shallowly punctate.

Head longer than wide, base rounded; eyes small, prominent, coarsely faceted, placed in front of the middle; antennæ inserted close to the eyes. Prothorax longer than wide, longer and about the width of the head, subcordate, apex slightly rounded, base constricted and truncate; an indistinct tubercle on each side at the base; median line feebly traceable at base and apex. Elytra not once and a quarter as long as head and prothorax combined, shoulders rounded, parallel-sided to near apex, or very feebly widening to about the middle, without depression. Legs slender; femora scarcely thickened; tibiæ straight, minutely spurred at their apices; four anterior longer, the posterior as long as tarsi, basal joint of posterior tarsi as long as the others combined, intermediate as long as 2nd-3rd, anterior short. Length $2\frac{1}{2}$, width $\frac{2}{3}$ mm.

Hab.—North-West Australia (Macleay Museum).

I do not know any species with which this very distinct one can be satisfactorily compared.

ANTHICUS SIMULATOR, n.sp.

Elongate, subdepressed, highly polished. Black; base of prothorax obscure piceous, each elytron with two small testaceous maculæ, one near the shoulder transversely triangular, the other about a third from the apex, parallel-sided, directed a little obliquely towards and truncate near suture; these maculæ are sometimes indistinct (especially the posterior); lower surface of

head and prosternum dull red; coxæ, base of femora—the posterior infusate towards apex—and tarsi obscure testaceous; antennæ piceous. Elytra very sparsely pubescent, rest of the body almost glabrous. Above minutely, beneath indistinctly punctate.

Head a little longer than wide, rounded; eyes, small, prominent; antennæ slender, inserted midway between eyes and apex of mandibles, reaching intermediate coxæ, 1st joint about once and a half longer than 2nd, 2nd a little longer than 3rd, 11th about the length of 9th-10th combined. Prothorax scarcely the width of head, longer than wide, transversely globose in front, strongly constricted near base; a small tubercle on each side at base. Elytra about as long as head and prothorax combined, about two and a half times as long as wide, base truncate, shoulders feebly rounded, sides feebly widening to beyond middle; a very feeble impression behind the base (only visible when viewed sideways). Legs slender; femora thickening towards apex, tibiæ straight. Length $1\frac{5}{8}$, width $\frac{3}{5}$ mm.

Hab.—Bridge Town, W.A. Between the leaves of cabbages.

I have a specimen from Donnybrook in which the whole of the prothorax is dull red. The species closely resembles *A. strictus* and *A. bembidioides*; from the former it differs in being narrower, with thicker antennæ, and by its more parallel elytra; from the latter by its differently shaped prothorax, with more prominent tubercles, and by its head being a little smaller.

ANTHICUS GEMINATUS, n.sp.

Narrow, elongate, subdepressed, shining. Testaceous, prothorax darker than elytra; head and apical half of elytra—except along suture—tinged with piceous, lower surface coloured as prothorax, legs paler, abdominal segments—except basal—piceous. Elytra moderately, head and prothorax very sparsely clothed with short pale pubescence, lower surface almost glabrous. Above densely and not very minutely punctate, each puncture carrying a small hair; sterna indistinctly punctate.

Head rounded, a little longer than wide; eyes small, prominent, in exact middle of sides; antennæ slender, slightly thickening

towards apex, reaching intermediate coxæ, 1st joint about once and a half as long as 2nd, 2nd-3rd equal. Prothorax fully as wide as head, longer than wide, rounded in front, constricted towards base; base smooth. Elytra about once and a quarter as long as head and prothorax combined, more than twice as long as wide, base truncate, shoulders feebly rounded, sides gradually widening to beyond the middle; feebly depressed on each side of suture towards apex. Legs not very long; femora thickened, posterior arcuate; tibiæ straight. Length $2\frac{1}{5}$, width $\frac{2}{3}$ mm.

Hab.—Bridge Town, W.A.

A second specimen from Bridge Town is a little smaller and paler, and has the elytral marking confined to an indistinct fasciate blotch across the middle. The species is similar in shape and colour to *A. exiguus*, differing in being larger, more feebly punctured, prothorax a little different, &c. Both my specimens were taken (in company with many other small beetles) under a stone, where they had retreated for protection against a fire.

ANTHICUS OVIPENNIS, n.sp.

Slightly convex, shining. Testaceous-red; elytra testaceous, and with a thin obscure piceous fascia across the middle, the apex faintly tinged with piceous; legs and abdomen pale testaceous, basal segment of the latter tinged with piceous. Elytra moderately clothed with short pale pubescence, denser and shorter on head and prothorax, rest of body almost glabrous. Head and prothorax shallowly punctate; the elytra densely and rather strongly, sides and sutures of sterna and basal abdominal segment minutely but (under microscope) distinctly punctate.

Head moderately large, subquadrate, eyes very small and prominent, placed a little in front of the middle; antennæ thin, very slightly thickening to apex, scarcely reaching intermediate coxæ, 1st joint thick, not much longer than 2nd, 2nd a little longer than 3rd, 11th almost as long as 9th-10th combined. Prothorax fully as wide as head, longer than wide, rounded in front, constricted towards base; base with traces of tubercles.

Scutellum very small, semicircularly triangular. Elytra no longer than head and prothorax combined, ovate, the shoulders strongly rounded, without impression. Femora thick, tibiæ straight. Length 2, width $\frac{2}{3}$ mm.

Hab.—Bunbury, W.A.

The short ovate elytra of this species should render it distinct; in colour it somewhat resembles the preceding.

ANTHICUS DELICATULUS, n.sp.

Elongate, depressed, shining. Head testaceous-brown, prothorax pale reddish-testaceous; elytra pale testaceous, a darker marking about scutellum and apex, each with a triangular macula, the apices of which meet at suture; sterna coloured as prothorax, legs paler, abdomen—basal segment excepted—stained with piceous. Clothed all over, sparsest on head, with very short pale pubescence. Head, prothorax and sterna sparsely and very minutely, elytra minutely punctate.

Head not very large, strongly rounded, a little longer than wide; eyes rather small and prominent, placed in the exact middle of sides; antennæ slender, feebly thickening to apex, inserted midway between eyes and apex of mandibles, reaching intermediate coxæ, 1st joint not as long as 2nd-3rd combined, 2nd a little thicker and shorter than 3rd, 11th not as long as 9th-10th combined, its apex rounded. Prothorax longer than wide, no wider than head across eyes, apex rounded, sides narrowing to beyond middle, and then feebly increasing to base; feeble traces of tubercles at base. Elytra not much longer than head and prothorax combined, wider than head, base truncate, shoulders feebly rounded, sides gradually widening to beyond the middle; suture depressed at base, a very feeble depression near shoulders. Femora thick, tibiæ straight. Length $2\frac{1}{3}$, width $\frac{3}{5}$ mm.

Hab.—North-West Australia (Macleay Museum).

A narrow pale species, not very close to any known to me. Another specimen is smaller, paler, and with the elytral markings very obscure.

SYZETONINUS PARALLELUS, n.sp.

♂. Elongate-ovate, subdepressed, shining. Black; elytra and lower surface very slightly paler than prothorax; legs and antennæ obscure testaceous, the latter infusate towards apex. Sparsely clothed with short obscure pubescence. Above very densely and strongly punctate, feeblest on head, strongest at base of elytra; sterna moderately densely and strongly, abdominal segments minutely punctate.

Head small, closely joined to prothorax, strongly transverse; eyes moderately large, not very prominent, placed close to base; antennæ reaching intermediate coxæ, 1st and 2nd joints large, thick, the 2nd equal to the swollen portion of 1st, 3rd equal in length to 2nd, but narrower, 3rd-10th gradually decreasing in length, 3rd-6th decreasing in width, 7th-11th thickening, 9th subquadrate, 10th transverse, 11th not as long as 9th-10th combined. Prothorax feebly transverse, as wide as head at base, truncate at base and apex, sides slightly rounded; a broad semi-circular interrupted impression extending almost across base, and a shallow impression across middle, the centre of which is plainly marked. Scutellum very small, narrowing towards and truncate at apex. Elytra more than twice as long as head and prothorax combined, base truncate, shoulders scarcely rounded, sides parallel to near apex; the base with a depression on each side and at suture, behind it a very shallow depression. Legs rather long and slender, posterior femora very slightly thickened, all the tibiæ straight. Length $1\frac{1}{2}$, width $\frac{2}{3}$ mm.

Hab.—Bridge Town, W.A.

Differs from *S. inconspicuus* by being a little more parallel, and in having darker elytra, a little feebler puncturation, somewhat different antennæ, &c.

SYZETONINUS BASICORNIS, n.sp.

♂. Oblong-oval, subdepressed, feebly shining. Head and prothorax black, elytra piceous-brown, the apex obscurely paler, base narrowly testaceous, lower surface piceous-brown, legs—especially

the anterior—and all the tarsi paler. Above sparsely clothed with short pubescence, longest and most distinct on apical half of elytra; lower surface with very minute pubescence. Head and prothorax very densely and rather strongly punctate; elytra coarsely and densely, sterna not very strongly, abdominal segments minutely punctate.

Head rather small, closely joined to prothorax, strongly transverse; eyes large, not prominent, placed close to base; antennæ inserted close to apex, 1st-5th joints cylindrical, 1st arcuate, as long as 2nd-3rd combined, 2nd thick, transverse, not half the length of 3rd, 3rd slightly bent, as long as 3rd-4th combined, 4th narrowest of all, 4th-10th subequal in length and gradually increasing in width, 9th-10th feebly transverse, 11th large, thick, apex strongly rounded, about the length of 3rd. Prothorax transverse, as wide as base of head, truncate at base and apex, sides feebly rounded; an oblique elliptic impression on each side at base. Elytra shaped as in the preceding. Legs long, posterior femora slightly thickened, posterior tibiæ very feebly bent inwardly. Length $1\frac{4}{5}$, width $\frac{4}{5}$ mm.

Hab.—Forest Reefs. (On a fence at dusk.)

The shape of the basal joints of the antennæ renders this species exceedingly distinct.

PYROCHROIDÆ.

LEMODES ELONGATA, n.sp.

Elongate, parallel-sided, subdepressed, the derm shining. Red (in some lights with a faint purplish gloss), undersurface—except mesosternum which is darker—very slightly paler than above; scutellum and eyes black; antennæ black, two basal joints red, third reddish-piceous, apical joint white. Above densely clothed with moderately long pubescence, which is almost concolorous with the derm; on the elytra it is placed in a wavy manner, causing them to appear indistinctly patterned; the whole upper-surface is rather sparsely clothed with long semiupright hairs, densest on elytra; undersurface, legs and antennæ with rather

short pubescence, tibiae with a few long hairs, antennae with blackish setae and rather long outstanding hairs. Head and prothorax with large shallow punctures, almost concealed by pubescence; elytra seriate-punctate (in about ten rows), the punctures large and coarse at base, becoming obliterated towards apex; mesosternum densely and strongly punctate; metasternum and abdominal segments densely and minutely punctate, the former with large scattered punctures; legs very densely and minutely punctate.

Head truncate at base, about as long as the width across eyes; eyes rather large, prominent and finely faceted; antennae rather stout, not quite reaching apex of metasternum, the distance between their bases slightly less than between them and the apex of mandibles, composed of twelve joints, 1st small, globular, distinctly separated from 2nd, 2nd larger, about the size of 7th, 3rd narrowest, 3rd-11th subequal in length and increasing in width, 12th not quite as long as 10th-11th combined, its basal half about the size and shape of 11th, decreasing then to apex. Prothorax wider than long, longer and slightly wider than head, strongly constricted towards and truncate at base, apex transversely globose; median canal distinct but shallow in the middle, obsolete at base and apex. Scutellum triangular, considerably longer than wide. Elytra parallel-sided to near apex, fully twice as long as head and prothorax combined, about once and a half as wide as the latter at base, base scarcely truncate, shoulders feebly rounded; a feeble depression near the base (only visible when viewed sideways). Margins of mesosternal keel finely carinate. Legs long, tibiae almost straight. Length $5\frac{1}{3}$, width $1\frac{1}{2}$ mm.

Hab.—Blackheath, N.S.W.

May be distinguished from either *L. coccinea* or *L. Mastersi* by its much more elongate form, less angular prothorax, longer scutellum, longer pubescence, distinctly twelve-jointed antennae, &c.; in both of those species the scutellum is transverse, in *Mastersi* rounded, and in *coccinea* truncate at apex. Members of this genus are subject to considerable alteration of colour if immersed for any time in spirits, the head and prothorax

frequently turning dark-brown, or almost black, the legs darker; the white joints of the antennæ in *coccinea* vary in number from one to three. The type is in the possession of Mr. George Masters, who has kindly given me another specimen, labelled N.S.W.

LEMODES CORTICALIS, n.sp.

Elongate, subparallel, slightly convex, the derm shining. Ferruginous, elytra—except at base and suture—slightly darker than prothorax; undersurface paler than above; legs and palpi testaceous; antennæ reddish-testaceous. Above covered with short silky pubescence, densest on elytra, and with longer upright hairs; undersurface, legs and antennæ with very short and pale pubescence, the latter with a few outstanding hairs. Anterior half of head densely and not strongly punctate, base almost impunctate; prothorax with strong, sparse, and with smaller and more numerous punctures; elytra densely and strongly punctate, the punctures strongest and arranged in rows at the base, becoming feebler and irregular towards apex, the whole surface covered with very minute punctures; undersurface of head polished; pro- and mesosternum moderately strongly, metasternum and abdominal segments minutely punctate.

Head with a distinct neck, triangular in shape (excluding neck), wider than long; eyes large, prominent; antennæ not very thick, passing intermediate coxæ, eleven-jointed, 1st large, as long as 2nd-3rd combined, and as long as 11th, 2nd-10th very slightly increasing in length, 2nd-5th subcylindric, 6th-10th obconic, 11th subcylindric, scarcely the length of 9th-10th combined. Prothorax feebly, if at all, transverse, wider in front than behind, anterior angles widely rounded, base truncate, sides deeply constricted near the base; median canal distinct but shallow, obsolete at apex. Scutellum very small and strongly transverse. Elytra not quite covering pygidium, parallel-sided almost to apex, about twice as long as head and prothorax combined, twice and a half as long as wide; base truncate, shoulders feebly rounded; a feeble depression midway between shoulders and suture. Legs long, tibiæ straight. Length $4\frac{1}{2}$ - $5\frac{1}{4}$, width $1\frac{2}{3}$ - $1\frac{1}{2}$ mm.

Hab.—Forest Reefs.

The colour of this species will at once distinguish it from any of its described congeners; in shape it comes closest to the preceding.

MORDELLIDÆ.

Many of the species of this family are difficult to satisfactorily describe, as almost the only characters that can be given are the size, colour and pattern of the markings. So far as I have noticed, the colour of the derm (with very few exceptions) appears to be reliable; the legs (especially the four anterior) and the antennæ are subject to sexual variation of colour; the pattern is not always to be relied upon, especially in old or greasy specimens (without reckoning abrasion); the colour of the pubescence is very apt to be affected by age or immersion in spirits (especially the white markings of the abdomen). I have fresh specimens of *M. multiguttata* and *M. leucosticta*, in which the maculæ are decidedly white, and older specimens in which they are as decidedly yellow; and similarly with other species. Many species are sexually constant as to size, but others are very variable. We have many species that are almost entirely black; they are moderately easily distinguished in the cabinet, but their specific distinctions are very hard to point out; in consequence I have delayed describing a number of uniques.

Many of my species were obtained from the flowers of tall *Eucalypts*, felled for the purpose of obtaining flowering, and afterwards dead-leaf beetles; and I believe there are many more species which can only be obtained in this manner; a few specimens were taken at night-time while crawling over old logs and stumps. Mr. Masters, on a recent trip to Blackheath, captured many hundreds of specimens by beating bushes into a sheet before sunrise; they were then very torpid, and were easily captured.

MORDELLA DUMBRELLI, n.sp.

♂. Black; tarsi piceous-black, base of antennæ, palpi and posterior spurs piceous-red. Head with pubescence which in some lights appears whitish, in others—especially at the base—having a piceous look; from some directions apparently with a white

median line. Sides of prothorax very narrowly edged with white; apex a little more broadly, from its middle a narrow stripe extending a little more than a third from the apex, there is also a small spot on each side; there are ten free or nearly free spots—four at the base, of which the two inner are the smallest; two on each side of the narrow stripe in front, in a line with each other, and one on each side of the middle behind it. Elytra not bordered at the base, each with seven small spots—one close to the scutellum, the smallest spot between it and the shoulder, two in a line behind them, the inner one not close to the suture; the outer close to the side (forming with a spot on the meso- and another on the metasternum a small triangle), a round spot close to the suture at about the exact middle, the largest spot in a straight line behind about a fourth from the apex, the last is close to and a little behind it at the side, the two forming an interrupted irregular oblique S. Each of the abdominal segments with four white spots, the two inner of each of which are narrow, and but little separated. Meso- and metasternum (except at the sides) pubescent as the head. A little white at the base of the aculeus.

Aculeus long, narrow; apex very sharply pointed, margined almost to the apex. Posterior spurs equal, about two-fifths of the length of the first tarsal joint. Length 12, width $3\frac{3}{4}$ mm.*

Hab.—Galston; on flowers of *Bursaria spinosa* (Dumbrell and Lea).

From *M. multiguttata* the present species may be distinguished by its broader form, more distinctly margined aculeus, more elongate abdominal spots; by its smaller elytral spots, those near the apex nearly separated or not at all joined together as in that species; the small spot forming a triangle with the two behind the basal ones is wanting in this species; the spots on the prothorax also cover much less surface.

MORDELLA 18-MACULATA, n.sp.

Black, legs scarcely lighter in colour. Head with silvery-grey pubescence which is parted in the middle. Prothorax with

* The lengths given are to the apex of aculeus.

silvery pubescence, enclosing on the apical two-fifths four equal-sized spots, extending in a narrow line from the middle of each of the two central ones about half-way to the base, sides narrowly margined, base narrowly margined and trisinuate, the middle sinus equal in width to the two lateral combined. Each elytron with numerous small silvery spots, two oblique ones at the base, one along suture, another near the middle, at its base close to the first but their apices widely separated, a very indistinct spot on shoulder, behind the middle spot and almost touching its apex there is a round one, at a short distance behind this is an oblique spot, outside this and slightly in advance of it and on the side is a small spot, slightly before the middle and close to suture an ovate spot, behind and midway between this spot and the apex is an irregular spot, which, with another one close to it, form an irregular interrupted oblique S. Undersurface with silvery-grey pubescence, more silvery at the sides, and leaving on the sides of the metasternum and abdominal segments small triangular patches. Aculeus with silvery pubescence at its base.

Aculeus rather long, broad at the base, moderately sharply pointed, strongly lessened about the middle. Posterior spurs unequal, the longest slightly curved, and fully half the length of the first tarsal joint. Length $4\frac{3}{4}$, width $1\frac{2}{5}$ mm.

Hab.—Forest Reefs.

A pretty, very distinct and rather robust little species, the markings of which are more in character with those of the larger species than among those of its own size. The markings of the prothorax—if always visible (I have but two specimens to judge from)—should render its identification easy.

MORDELLA LATICEPS, n.sp.

Black; antennæ and anterior femora reddish-piceous. Head with obscure griseous pubescence; prothorax at its apex and sides, and the scutellum with dirty pale yellow pubescence. Elytra with similarly coloured pubescence narrowly bordering the base, covering the shoulders from which a stripe (not, however, always present) runs obliquely towards the suture, close to which it

terminates in a moderately large spot, at about a third from the apex a moderately large irregular transverse spot. Meso-, sides and middle of metasternum, and abdominal segments, and base of aculeus with griseous pubescence.

Scutellum with a shallow depression at its base. Aculeus rather long, very broad at the base, suddenly triangularly lessened, apical half almost parallel-sided, truncate at apex. Posterior spurs unequal, the longest half as long as first tarsal joint, and fully twice as long as its fellow. Length $4\frac{1}{3}$ -5, width $1\frac{4}{5}$.

Hab.—North West Australia (Macleay Museum).

A broad robust species with a very broad head. I have examined seven specimens, but they have all been very dirty; the species is very distinct, and an examination of fresh specimens would probably discover additional markings.

MORDELLA AUSTRALIS, Boisd. (?); Mast. Cat. Sp. No. 4314.

Black; muzzle, base of antennæ, anterior legs and intermediate femora testaceous. Head with greyish pubescence at the base on each side appearing almost bare. Prothorax with silvery pubescence, with a median and two lateral vittæ. Elytra at the base with four stripes, one on each side of the suture projecting outwardly, the others midway between suture and sides; a narrow zigzag fascia at the middle composed of three V's, the central one somewhat irregular; near the apex a narrow fascia—not always complete. Meso-, sides and apex of metasternum, sides and middle of abdominal segments, and base of aculeus with greyish pubescence.

Aculeus moderate, suddenly lessened at about its middle, apex pointed. Posterior spurs unequal, the longest not quite half as long as the first tarsal joint. Length $2\frac{3}{4}$ - $3\frac{1}{2}$, width $\frac{4}{5}$ - $1\frac{1}{5}$ mm.

The above is the description of a widely distributed species which I take to be *M. australis*; it is the species labelled by the late Sir W. Macleay as such in his own museum (though not the species he named as such from Gayndah). Boisdual's description is very brief (12 words), certainly insufficient for its positive identification.

MORDELLA FESTIVA, n.sp.

Black; palpi, base of antennæ, anterior legs and posterior spurs obscure testaceous. Head with obscure pubescence which is parted in the middle. Prothorax with dull silvery pubescence, leaving an elongated vitta and two lateral spots. Elytra with pubescence as prothorax; it narrowly borders the base on each side, emitting three stripes, the first about the middle, one at the extreme side, and one between them; a zigzag fascia about the middle—not quite reaching the sides—forming two irregular W's; a crescent-shaped spot on each side about a fourth from—and with its convex sides towards—the apex; the pubescence extends along the suture from the scutellum to the fascia (one specimen has the elytral pubescence extending from base to apical spots, these latter conjoined and irregular in shape). Undersurface with silvery-grey pubescence, leaving a spot on each side of the abdominal segments, and the greater part of aculeus.

Aculeus short, broad; apex broad, truncate. Legs rather slender; posterior spurs equal, and little more than a third the length of the first tarsal joint. Length $3\frac{3}{4}$, width $1\frac{1}{4}$ mm.

Hab.—South Australia (Rev. T. Blackburn).

Resembles the species I suppose to be *M. australis*: differs in being larger, narrower, the markings broader and not so clearly cut, without the divergent scutellar stripes, thinner femora, somewhat different aculeus, &c. Mr. Blackburn tells me that he thinks this species an extreme variety of *M. communis*; with this opinion, however, I cannot agree; none of my specimens of that species approach it in pattern.

MORDELLA BELLA, Waterh.; Mast. Cat. Sp. No. 4315.

This is an extremely variable and widely distributed species. I have specimens from many parts of New South Wales, and there are specimens in the Macleay Museum from Queensland and South Australia. Mr. George Masters at Blackheath recently obtained several hundreds of specimens, all of which, together

with my own specimens, I have carefully examined. The prothoracic maculæ are sometimes distinctly marked, often indistinct, and frequently entirely absent; frequently the entire basal half of the elytra is covered with golden, grey, or occasionally silvery pubescence; where the basal half is not so covered there is often to be seen an indistinct fascia similar to the middle one, occasionally appearing as indistinct elongate spots; the middle fascia is always of the shape described by Mr. Waterhouse, though varying in thickness; the apical fascia varies in thickness, being often straight, sometimes complete, often divided into transverse, and occasionally into sublunate spots; the size also is subject to considerable variation.

MORDELLA LIMBATA, Waterh.; Mast. Cat. Sp. No. 4325.

This is a somewhat variable species, many specimens having the elongate black spot of each elytron almost obliterated; others again have it touching the suture, the pubescence behind it being lunulate in shape; the prothoracic maculæ are often very indistinct; the pubescence in many is bright silvery; it is sometimes very difficult to decide whether a specimen belongs to this species or to *M. bella*.

Hab.—Rope's Creek (Mr. G. Masters); Braidwood, Galston (Lea).

MORDELLA H-FASCIATA, n.sp.

Black; muzzle (palpi in ♂), base of antennæ and spurs obscure testaceous. Head with obscure pubescence, which is feebly parted in the middle. Prothorax with obscure yellowish pubescence bordering the base, and forming some very obscure longitudinal stripes (there are traces of three maculæ in some specimens).

Elytra with greyish-yellow pubescence, not bordering, but extending in a short triangle from the middle of each side of the base; extending close on each side of suture from the scutellum to a little beyond the middle, at the base and apex of these almost conjoined stripes there are two very short conjoined elongate spots (sometimes free), which cause the whole to appear as an H or a broad-footed T, almost touching each other on each side.

of the suture near the apex is an elongate narrow stripe. Meso-, middle and sides of metasternum and abdominal segments, and base of aculeus with obscure pubescence.

Aculeus moderately long, broad at the base, strongly lessened from there to beyond the middle, then narrow, apex pointed. Posterior spurs unequal, longest about two-fifths the length of the first tarsal joint. Length $3\frac{3}{4}$ -5, width $1\frac{2}{5}$ - $1\frac{1}{2}$ mm.

Hab.—Forest Reefs.

The markings of the elytra are sufficient to render this species easy of identification; at first sight it resembles *M. limbata*, than which it is slightly broader.

MORDELLA COMMUNIS, Waterh.; Mast. Cat. Sp. No. 4317.

From New South Wales I have numerous specimens which agree in all particulars with the descriptions of this species; they are all dingy, many of them having a greasy look, caused by a sprinkling of greyish pubescence; the elytral maculae are often obsolete, and they are never very clearly defined.

MORDELLA FELIX, Waterh.; Mast. Cat. Sp. No. 4321.

I have this species from Blackheath (Masters), and Forest Reefs (Lea). Mr. Waterhouse in describing it says:—"Head . . . with a distinct longitudinal *impressed* line"; this should read "pubescence *parted* in the middle," a character common to most species; very few have an impressed line.

MORDELLA TRIVIALIS, Waterh.; Mast. Cat. Sp. No. 4334.

I have two specimens—one from Galston and the other from Newcastle—which agree very well with Mr. Waterhouse's description of this species; he omits to mention the colour of the posterior spurs; in my specimens they are piceous-black; in the Newcastle specimen the anterior femora are reddish-testaceous, the intermediate somewhat darker; in the Galston specimen all the legs are concolorous.



MORDELLA FUGITIVA, n.sp.

Black; palpi and basal joints of antennæ piceous-red. Head with griseous pubescence, which is not parted in the middle. Prothorax with base and apex extremely narrowly bordered with greyish pubescence. Scutellum in some lights silvery, in others black. Elytra with two narrow fasciæ—which when looked at from the apex are scarcely visible, from in front appearing bright silvery—the first is almost in the exact centre, and is zigzag in shape, appearing in frönt as two irregular W's, at the back as two perfect M's; the other fascia is about a fourth from the apex, and is composed of two united spots, the apical edge straight, concave internally. Sides of meso-, and metasternum, abdominal segments and base of aculeus with pubescence as elytral fasciæ, anterior femora as head.

Posterior spurs unequal, longest about half the length of the first tarsal joint. Length $7\frac{1}{2}$, width $2\frac{3}{5}$ mm.

Hab.—Forest Reefs.

MORDELLA RAYMONDI, n.sp.

Entirely black. Head with griseous pubescence, which is feebly parted in the middle. Silvery pubescence on upper surface as follows:—narrowly edging prothorax, distinct at its base, obscure at apex and sides; scutellum covered or not; each elytron with three extremely short obscure stripes (frequently absent), the most distinct touching scutellum, one in the middle of the base, the other on the shoulder, a small spot behind the base equidistant from it, the side and suture, at the middle a V (the two when looked at from the base forming a perfect W), near the apex and close to the suture (sometimes touching it) an irregularly shaped spot. All the margins of meso- and metasternum, sides of abdominal segments and upper base of aculeus with silvery pubescence.

Posterior spurs unequal, longest about two-fifths the length of the first tarsal joint. Length $5\frac{1}{2}$, width $1\frac{1}{2}$ mm.

Hab.—Mt. Kosciusko (Mr. W. Raymond).

The pubescence of the elytra and undersurface of this species is similar in character to the preceding, but it is never so brilliantly silvery.

MORDELLA ÆMULA, n.sp.

Differs from *M. fugitiva* in being smaller, narrower, the elytral pubescence less strongly marked, two small spots near apex of elytra, base of antennæ obscurely piceous; posterior femora piceous-black, but distinctly lighter in colour than abdomen; and by the aculeus. Length 7, width $2\frac{1}{4}$ mm.

Hab.—Mt. Kosciusko (Mr. W. Raymond).

As the four preceding species strongly resemble each other it may be as well to point out their chief differential characters. *M. trivialis* has the head and prothorax densely and equally covered with griseous pubescence, the aculeus long, narrow and nowhere suddenly lessened. The other three species have the head only covered with griseous pubescence, and that not so bright as in *trivialis*. *M. Raymondi* has the aculeus shorter than in *trivialis*, strongly lessened about its middle, then very gradually decreasing in width to apex, which is truncate. *M. fugitiva* has the aculeus short, suddenly lessened at about its middle, rather broad and parallel-sided from there to apex, the apex truncate. *M. æmula* has the aculeus fully as long, but not so narrow as that of *trivialis*, its sides very feebly diminishing in width from base to apex, apex sharply truncate.

MORDELLA MASTERSI, n.sp.

Black; posterior spurs testaceous. Covered all over with greyish pubescence, paler and shorter on the undersurface; on the elytra there are very indistinct traces of markings towards the apex.

Aculeus long, from the base to about the middle decreasing in width as the elytra, from the middle narrow, apex sharply pointed. Posterior spurs subequal, about two-fifths the length of the first tarsal joint. Length $3\frac{3}{4}$ - $4\frac{1}{4}$, width $1\text{--}1\frac{1}{3}$ mm.

Hab.—Rope's Creek (Mr. G. Masters).

An elongate and rather pretty little species, having pubescence somewhat similar in character to that of *M. inusitata*.

In dedicating this species to Mr. George Masters, our veteran entomologist, I would like to place on record my gratitude to him for the very great kindness he has always shown me, in giving me advice on collecting and preserving, in giving new and rare species which I could never otherwise have obtained, in comparing species with those in his own and the Macleay Museum Collections, pointing out the variations of different species, and in many other ways being of considerable service to me.

MORDELLA 6-LINEATA, n.sp.

Black; antennæ testaceous at base, piceous-brown towards apex; palpi testaceous, brown at apex; four anterior tibiæ and tarsi piceous-black, posterior spurs testaceous. The pubescence is purplish—on the elytra with a shifting, steel-blue gloss (most noticeable when a light is thrown on the apex). White hairs; sparse on the head; narrowly bordering the prothorax; sparse on the shoulders; and forming three short, rather feeble, very narrow lines down the middle of each elytron, the inside one of which is feebly traceable on to the shoulders, the middle one the shortest; a few white hairs also down the suture; undersurface as the head.

Aculeus short, wider than deep, apex truncate. Posterior spurs unequal, the longest more than twice the length of its fellow, and about three-quarters the length of the first tarsal joint. Length $3\frac{1}{2}$, width $1\frac{2}{3}$ mm.

Hab.—Galston.

A short, robust species, wider than deep ($1\frac{2}{3} \times 1\frac{1}{2}$ mm), the elytra not narrower at apex than at base. It is proportionately broader than any species known to me.

MORDELLA IGNOTA, n.sp.

Black; antennæ and palpi testaceous, the former slightly darker towards the apex; anterior legs testaceous, basal half of femora and tarsi piceous; four posterior legs black; spurs to posterior reddish. Above with silvery-grey pubescence, pure on the head,

mixed with sooty on the disk of prothorax; elytra with more sooty than grey hairs, the grey most numerous at the base, becoming sparsely sprinkled and disappearing before the apex is reached. Undersurface with silvery-grey pubescence with a yellowish tinge, densest on the legs; abdominal segments—except at their bases—with sooty pubescence.

Scutellum subquadrate, slightly depressed in the middle. Aculeus narrowly margined, base rather broad, gradually decreasing to the apex, which is truncate. Posterior spurs equal, about two-fifths the length of the first tarsal joint. Length $6\frac{1}{3}$, width $1\frac{2}{3}$ mm

Hab.—Sydney.

Proportioned much the same or a little broader than *M. setipes*, and with a broader aculeus. I have a number of specimens recently taken by Mr. Masters at Rope's Creek which agree in all respects with the above description, except that the colour of the base of the antennæ and anterior legs is very obscure.

MORDELLA ALBO-SCUTELLATA, n.sp.

Black; antennæ piceous, basal joints piceous-red, mouth obscurely red, anterior legs with femora and tibiæ piceous-red or reddish-piceous, tarsi piceous, posterior spurs obscure red; head (in some lights) with a steel-blue tinge. Head densely covered with silvery-yellow pubescence (which when looked at from the side appears to be parted in the middle, and one side darker than the other), pubescence on prothorax somewhat darker (in some specimens very obscure), at the base with traces of three very indistinct maculæ (these can sometimes be followed, when the middle one appears almost parallel-sided, and continuous from base to apex). Scutellum—and elytra narrowly at the base—pubescent as the head, shoulders as the prothorax, the rest of the elytra appearing sooty, but when a light is thrown on it somewhat purplish. Undersurface pubescent as head; sides of metasternum, aculeus and abdominal segments (including a small part of the basal) with purplish pubescence, sides of the basal segment lighter than in the middle.

Head with a very shallow depression in front. Aculeus short, thick, wider than deep, truncate at apex. Posterior spurs equal, not much more than a third the length of the first tarsal joint. Length $5-6\frac{1}{2}$, width $2-2\frac{1}{2}$ mm.

Hab.—Braidwood, on flowers of *Bursaria spinosa*; Forest Reefs.

A robust, dirty looking species (closely resembling the preceding), more densely pubescent on the undersurface than above; the scutellum when viewed from some directions appears almost white.

MORDELLA INCONSPICUA, n.sp.

Black; base of antennæ, femora, and base of four anterior tibiae and posterior spurs, testaceous-red. Head and prothorax with very obscure greyish pubescence, the latter with feeble traces of maculæ; scutellum in some lights appearing whitish; base, shoulders, and the suture for a short distance, with obscure pubescence; undersurface with dirty-grey pubescence, forming no distinct markings.

Aculeus short, broad at base, nowhere suddenly lessened, apex very narrow but truncate. Posterior spurs scarcely equal, longest little more than half the length of the first tarsal joint. Length $3-3\frac{1}{2}$, width $1\frac{1}{3}$ mm.

Hab.—Inverell.

Differs from *M. aterrima* in being smaller, narrower, with a narrower and somewhat differently shaped aculeus, and by its impure pubescence. Living specimens of *M. aterrima* have very pretty purplish and steel-blue reflections, which, to a great extent, they lose shortly after death.

MORDELLA TRISTIS, n.sp.

Black; anterior tarsi piceous-black; antennæ piceous, basal joints somewhat paler; posterior spurs obscure red. Above with sooty-yellow pubescence, sparse and very minute on head, and narrowly marking the suture, sooty on the rest of elytra; sterna and legs pubescent as above; abdominal segments with sooty pubescence, the three basal with an obscure whitish spot at the sides.

Scutellum very small. Aculeus rather long, basal two-fifths narrowly margined, unmargined portion much narrower, apex truncate. Posterior spurs unequal, the longest twice the length of its fellow, and not half the length of the first tarsal joint. Length $4\frac{3}{4}$, width $1\frac{2}{3}$ mm.

Hab.—Mt. Kosciusko (Mr. W. Raymond).

The elytra have an indistinct steel-blue reflection when a light is thrown on to them, the reflection on the head becoming greenish. From *M. aterrima* it may be distinguished by its more shining derm and sparser pubescence, but in particular by its aculeus, which is much narrower, especially at the apex.

MORDELLA UNIFORMIS, n.sp.

Black; posterior spurs testaceous (♂ with anterior legs and base of antennæ obscurely reddish). Equally covered all over with obscure greyish pubescence (sometimes with a yellowish tint).

Scutellum very small. Aculeus rather long and sharp pointed, about as wide as deep, nowhere suddenly lessened. Posterior spurs equal, a little more than half the length of the first tarsal joint. Length $1\frac{3}{4}$ - $2\frac{1}{3}$, width $\frac{1}{2}$ - $\frac{2}{3}$ mm.

Hab.—Galston, on flowers of freshly felled "White Gum," Sydney, Como, Forest Reefs.

I suspect this is the species spoken of by the Rev. T. Blackburn as occurring in Sydney and the Blue Mountains, and as very likely to be distinct from *M. baldiensis*. At Galston I could have taken thousands of specimens; the branches when beaten into an umbrella appeared to rain them.

MORDELLA RUFIPES, n.sp.

This species would, I think, be best described by comparison with the preceding species, which it strongly resembles. From it, it differs in being somewhat broader; aculeus much shorter; four anterior legs testaceous, the femora stained with piceous; posterior femora black, their apices, the tibiæ and tarsi testaceous-red, tibiæ and tarsi tipped with black; posterior spurs unequal in

length, longest slightly bent, about half the length of first tarsal joint. Length $1\frac{3}{4}$ - $2\frac{1}{2}$, width $\frac{2}{3}$ mm.

Hab.—Sydney.

In some lights there appears to be a dark stripe down the suture. The colour of the posterior tarsi is the distinctive feature of this species.

MORDELLA FUSCA, n.sp.

Head, prothorax and undersurface piceous-black; elytra, antennæ, legs (one specimen has the posterior femora black), the apex of metasternum and abdominal segments piceous-brown; spurs to posterior tibiæ testaceous. Rather sparsely covered all over with yellowish-grey pubescence.

Aculeus moderately long, broad at the base, strongly narrowed about the basal third; apex sharply pointed. Posterior legs thick, spurs equal and half the length of the first tarsal joint. Length 3, width $\frac{3}{4}$ mm.

Hab.—Forest Reefs, Tamworth.

Somewhat resembling *M. setipes* in appearance, differing from it in being more robust, smaller and somewhat differently coloured.

MORDELLA SETIPES, n.sp.

Castaneous, four anterior legs and antennæ paler, abdominal segments with their margins narrowly paler; four posterior tibiæ and posterior tarsi tipped with piceous; posterior tibiæ and tarsi with stiff compressed piceous setæ. Covered all over with yellowish pubescence, densest on elytra, longest on sides of meso- and metasternum.

Aculeus rather long, broader than deep, basal half narrowly margined. Longest spur of posterior tibiæ about the length of the first tarsal joint, shortest not a fourth. Length $4.5\frac{1}{2}$, width $1(\text{vix})-1\frac{1}{2}$ mm.

Hab.—Galston, Tamworth, Forest Reefs, Sydney; beaten from drying leaves of Eucalypts not long felled.

An elongate, very shining species, varying slightly in colour. I have several small specimens from Sydney which I cannot separate from this species.

MORDELLA HUMERALIS, Waterh.; Mast. Cat. Sp. No. 4322.

This is another common and variable species. In many specimens the yellow elytral stripe does not turn up to join the suture; sometimes the stripe is bare, sometimes covered with yellowish pubescence, which occasionally extends right across; the two connected stripes often appear as a cleanly cut W, more frequently the outer edges are jagged or rounded; the spots near the apex of each elytron are often joined, appearing as a narrow crescent, which has its convex side towards the apex, sometimes as a single moderately large spot, and—rather rarely—all are united to form a transverse fascia; the yellowish pubescence frequently extends along the suture from the base to in line with the apical spots. The prothoracic maculæ are often distinct, and equally as often entirely obsolete. I have a specimen in which the elytral pubescence appears as four distinct maculæ. The size is somewhat variable.

Hab.—Blackheath (Mr. G. Masters); Tamworth, Forest Reefs, Sydney (Lea).

MORDELLA PULCHRA, n.sp.

Black; abdomen bright red, aculeus piceous-black at apex; four anterior coxæ, femora and the palpi brownish-testaceous, tibiæ and tarsi darker; antennæ reddish-piceous, at the base testaceous; spurs to posterior tibiæ testaceous. Head and prothorax not very densely clothed with somewhat silvery pubescence, on the latter three indistinct black maculæ, the largest extending from near the base to near the apex, the lateral ones oblique, almost touching the central. Elytra with silvery pubescence as follows: between the suture and sides an elongate somewhat triangular spot, narrowly joined to the suture at the base; on the shoulders a rather indistinct spot, which can hardly be separated from the inner one; two transverse zigzag fasciæ, one slightly before the middle, the other before the apex, the one in the middle very narrow at the sides, broadest at the suture, from the sides (on its anterior edge) running obliquely backwards, then up, down, up, and then semicircularly to the suture, its posterior edge triangular

at the suture; the hinder fascia straight at its posterior edge, trisinate in front; suture from the anterior, and margin from the posterior fascia, with a few silvery hairs. Undersurface with silvery pubescence, partly denuded on meso- and metasternum; the abdominal segments when looked at from almost every direction with the sides at the apex apparently semicircularly denuded.

Aculeus short, broad, basal two-thirds narrowly margined; apex narrow, truncate. Posterior spurs unequal, the longest about two-fifths the length of the first tarsal joint. Length $4\frac{3}{4}$, width $1\frac{1}{2}$ mm.

Hab.—Sydney.

This is a rare and very pretty species, easily distinguished by its red abdomen in striking contrast to the general colour.

MORDELLA PALLIDA.

Pale testaceous, elytra slightly darker, their apices darker still; abdominal segments piceous, their apices and sides and the aculeus piceous-red; eyes black; antennæ—except at base—slightly darker than head; posterior tibiæ and tarsi tipped with piceous, intermediate to a less noticeable extent, anterior not at all. Covered all over (but shortest and sparsest on meso- and metasternum) with short, yellowish, silky pubescence. Meso- and metasternum distinctly punctate.

Aculeus very short, rather flat, truncate at apex. Posterior spurs unequal, longest nearly three-fourths the length of the first tarsal joint. Length $2\frac{1}{2}$, width $\frac{2}{3}$ (vix) mm.

Hab.—Galston; on flowers of "White Gum."

A species easily recognisable by its pale colour, with dark abdomen and the absence of maculæ, and by the great length of its posterior spurs.

MORDELLA WATERHOUSEI, n.sp.

Testaceous; elytra with a zigzag fascia slightly behind the middle—forming three V's in front and four behind (one specimen has it broader, more confused, and extending slightly in front of the middle)—and the apical fourth piceous-brown; abdominal

segments and posterior tibiae and tarsi tinged with brown; aculeus piceous-brown. Covered all over (except on elytral markings) with yellowish silky pubescence, which is longest above; posterior tibiae and tarsi edged with blackish setae. Prothorax with three rather indistinct maculae, the median rather narrow and lanceolate in shape, the outer ones small.

Aculeus rather short and broad, strongly lessened about the middle; apex narrow, feebly rounded. Posterior spurs unequal in length, the longest fully half the length of the first tarsal joint. Length $2\frac{3}{4}$, width 1 mm.

Hab.—Blackheath (Mr. G. Masters).

MORDELLA V-FASCIATA, n.sp.

Reddish-testaceous; prothorax with a faint piceous spot in the middle; elytra black, the shoulders reddish-testaceous, an oblique stripe extending from them to the suture at a little more than half its length, becoming very indistinct as it approaches the suture, the two forming an elongated V. Metasternum stained with piceous at the sides; abdominal segments black, narrowly edged with obscure red; four posterior tibiae and tarsi tipped with piceous; antennae piceous, the two basal joints testaceous. Covered with greyish pubescence, silvery on elytral stripe and basal segment of abdomen.

Aculeus long, narrow (but wider than deep), apex sharply pointed. Posterior spurs unequal, the longest about half the length of the first tarsal joint. Length $2\frac{1}{2}$, width $\frac{3}{5}$ mm.

Hab.—Galston (Lea); Blackheath (Mr. G. Masters).

I have two specimens which in all structural details agree exactly with the types of the above species; the markings are somewhat different, but an examination of a number of specimens would probably discover intermediates. For the present I think them deserving of varietal rank.

var. VENUSTA.

Black; muzzle, prothorax, an oblique humeral stripe (broad at the base, narrowing and almost touching suture at its middle),

four anterior legs and posterior femora testaceous-red; posterior femora and abdominal segments dark piceous-brown; antennæ reddish, apical joints infusate. Elytra with yellowish pubescence along humeral stripe, and a rather large spot near apex of each (apparently concealing an obscure reddish spot).

Hab.—Blackheath (Mr. G. Masters).

var. *MODESTA*.

Black; muzzle, prothorax (its middle infusate), a squarish patch on shoulders and four anterior legs testaceous-red; posterior tibiæ and tarsi obscure red; abdominal segments piceous-black; antennæ brown, basal joints paler. Elytra with yellowish pubescence on humeral spots and along suture.

Hab.—Forest Reefs.

MORDELLA DISTINCTA, n.sp.

Black; a squarish patch on shoulders, four anterior legs and posterior tarsi obscure testaceous-red; posterior femora and abdominal segments dark piceous-brown; antennæ testaceous-red at base, darkening to brown at apex. Humeral maculæ, under-surface and legs with obscure greyish pubescence.

Aculeus moderately long, rather wide at base, and moderately sharply pointed, strongly narrowed near the base. Posterior spurs hardly equal, the longest not quite half the length of the first tarsal joint. Length $2\frac{3}{4}$, width 1 (vix) mm.

Hab.—Blackheath (Mr. G. Masters); Forest Reefs (Lea).

A species with a larger prothorax than is usual among its congeners. The humeral spots should be a very distinctive feature.

MORDELLA WIBURDI, n.sp.

Black; elytra with a testaceous-red stripe extending from the shoulders almost to the apex; four anterior legs testaceous, posterior tibiæ and tarsi somewhat darker, their apices piceous, posterior femora black; antennæ testaceous-red, apical joints darker. Head and prothorax somewhat sparsely clothed with silvery-yellow pubescence, elytra with golden—sometimes almost

connected--pubescence on the stripes; the pubescence on the undersurface is similar to that on the head and prothorax, on the abdominal segments (except the basal) and the aculeus it is sparse and purplish.

Aculeus rather long, as wide as deep, margined on the basal half. Posterior femora and tibiæ rather short and thick, spurs unequal, the longest not half the length of first tarsal joint. Length $1\frac{3}{4}$ -3, width $\frac{2}{5}$ - $\frac{4}{5}$ mm.

Hab.—Galston, on flowers of "White Gum," Como, Sydney (Lea); Blackheath (Mr. G. Masters); Jenolan Caves (Mr. J. C. Wibur).

A rather narrow species, which may be distinguished from *M. nigrans* by its much smaller size and by the colour of its legs, that species having them entirely black.

MORDELLA LONGIPES, n.sp.

♂. Reddish-testaceous; elytra with the suture narrowly black its entire length, the sides from near the shoulders stained with brown, which gradually encroaches upon, but never completely darkens the surface near the suture (when looked at from a little distance there appear to be two narrow rather dull testaceous vittæ extending the whole length of the elytra), abdominal segments and aculeus piceous-brown, their apices obscurely reddish; antennæ—except basal joints—brownish, posterior tibiæ and tarsi red, their apices darker. Above with yellowish pubescence, on the elytra only at base and on each side of but not on the suture, the rest of its surface being covered with obscure purplish pubescence; posterior tibiæ and tarsi edged with blackish setæ. Prothorax with three maculæ, the central one large and feebly marked, the outer ones very indistinct.

Aculeus long, narrow and sharp-pointed; posterior spurs unequal in length, the longest more than half the length of the first tarsal joint. Length 3 - $3\frac{2}{5}$, width $\frac{3}{4}$ (vix) mm

Hab.—Forest Reefs.

♀. Differs in being very slightly broader, aculeus broader and shorter and the abdominal segments scarcely stained.

An elongate species, having a more parallel outline than any other species (except *M. elongatula*) known to me.

M. LEUCOSTICTA, Germ.; Mast. Cat. Sp. No. 4324.

Hab.—Tamworth, Queanbeyan, Forest Reefs, &c.

M. CUSPIDATA, MacL.; Mast. Cat. Sp. No. 4318.

Hab.—Tamworth.

M. ATERRIMA, MacL.; Mast. Cat. Sp. No. 4313.

This species is widely distributed in New South Wales and Queensland.

M. MULTIGUTTATA, Waterh.; Mast. Cat. Sp. No. 4237.

Hab.—Sydney, Forest Reefs (Lea), Jenolan Caves (Mr. J. C. Wiburd).

M. RUFICOLLIS, Waterh.; Mast. Cat. Sp. No. 4322.

Hab.—Blackheath (Mr. G. Masters), Mossman's Bay (Macleay Museum).

M. OBLIQUA, Waterh.; Mast. Cat. Sp. No. 4328.

Hab.—Rope's Creek (Mr. G. Masters).

M. INUSITATA, Blackb.; T.R.S.S.A. 1893, p. 136.

Hab.—Sydney, Galston.

M. CARA, Blackb.; T.R.S.S.A. 1893, p. 137.

Hab.—Sydney, Galston (Lea), Rope's Creek (Mr. G. Masters).

M. SYDNEYANA, Blackb.; T.R.S.S.A. 1893, p. 137.

Hab.—Queanbeyan, Tamworth, Forest Reefs, Galston.

M. BALDIENSIS, Blackb.; T.R.S.S.A. 1891, p. 341.

Hab.—Braidwood, Forest Reefs, Galston (Lea), Rope's Creek, Blackheath (Mr. G. Masters).

CURCULIONIDÆ.

SOSYTELUS RUGICOLLIS, n.sp.

Short, thick, rough, opaque. Black; claws feebly diluted with red. Extremely minutely punctate all over. Base of head and antennæ with small griseous scales, smaller, sparser and duller at sides of prothorax, undersurface and legs.

Head short, thick; with short setæ; a moderately large tubercle close to the eyes; rostrum excavated, at its apex a triangular and raised emargination. Disk of prothorax with three excavations, the central one continuous from base to apex, and open at both ends, the lateral ones a little shorter, semicircular outwards, closed at apex, irregularly and narrowly open behind; on the summits of the excavations and the sides there are a number of large, shallow setose punctures, some of them in the centre of a feebly raised tubercle; sides angularly produced in the middle. Elytra not twice the length of head and prothorax combined; the disk very feebly striate-punctate, each puncture carrying a small seta, at the sides the striæ are five in number and very feeble, but the punctures are rather large and distinct; the 3rd and 6th interstices strongly raised, costiform and setose, the 3rd slightly produced at the base, interrupted towards and tuberculate at apex; the 6th produced at the shoulders, extending for about a fourth the length of prothorax, interrupted towards and tuberculate at apex; in consequence of the interruptions of these costæ there is a transverse row of four tubercles; these when looked at from behind appear as short conical elevations, the two outer more obtuse; apical third declivous, with rows of rather strong punctures, the strongest close to suture. Sterna irregularly punctate, apex of mesosternum with three transverse rows of strong punctures. Abdominal segments obsoletely punctate. Legs rather short, setose, the coxæ irregularly punctate and densely setose. Length $10\frac{1}{2}$, width $4\frac{1}{2}$ mm.

Hab.—Queanbeyan, N.S.W.

I have a specimen from Cootamundra, which is a little shorter and narrower, and which has the elytra densely covered with small, round, griseous-brown scales.

GLOCHINORRHINUS EVANIDUS, n.sp.

♂. Thick, opaque, rounded in front and behind. Black; prothorax with a narrow margin anteriorly and the antennæ, piceous-red. Above covered with small ashen scales, densest and palest on rostrum; on the sterna the scales are more distinct and paler, they are densest and elongate behind the prosternal canal; on the abdominal segments there are short, round and elongate, paler scales, densest on the basal and apical, and forming three lines on the intermediates; legs—especially tibiæ—densely scaly. Head with short dark setæ, becoming setose hairs on rostrum; prothorax setose, the setæ short and dark on the disk, pale and elongate at the sides; elytra sparsely setose. Densely and very minutely punctate all over; apex of rostrum coarsely and densely punctate, undersurface more sparingly and feebly; prothorax at sides with rather large shallow punctures, elytra seriate-punctate, punctures large and round, deepest at the sides.

Head with a shallow fovea between eyes; antennæ short, subshining; rostrum subparallel, slightly widest at apex, minutely granulate, obtusely carinate from the base to between bases of antennæ, the sides slightly in front of the middle with a strong recurved spine, behind that a shorter curved spine, behind that again there are a number of small tubercles, there is also a tubercle in the middle immediately in front of eyes; undersurface highly polished, obtusely carinate down the middle, impressed towards the sides at base, a short tubercle behind the antennal scrobes. Prothorax slightly longer than wide, and wider than deep, base narrowly margined, the middle produced, the sides behind the eyes broadly emarginate, much narrower in front than the middle or behind; median line feebly marked till near the apex, where there is a short shining carina. Scutellum short, rounded, transverse. Elytra at base scarcely as wide as prothorax at its widest, and about once and a third as long; gradually

narrowing to near apex, at the base wider than deep, becoming deeper than wide at posterior coxæ; each elytron with a row of about ten small shining tubercles close to suture, the second interstice bearing the largest tubercle, irregularly shaped, close to the base and equidistant from suture, behind it there are a number of irregular, obsolete setose tubercles, forming a slightly elevated costa which terminates at more than a third from the apex. Legs long; tibiæ flattened and spurred at apex, a few setæ on the other side causing them to appear bispinose; basal joint of tarsi elongate, grooved beneath. Length 11 (rostr. excl.), width $4\frac{1}{2}$ mm.

♀. Differs in having the rostrum smooth, narrow, without scales or setæ, and almost impunctate, tibiæ shorter, &c.

Hab.—North Queensland, Barron Falls (Mr. A. Koebele); Cairns (Mr. W. W. Froggatt).

This species is much the form and size of *G. Doubledayi*, from which it may be readily distinguished by its somewhat broader form, nontuberculate and feebly carinated prothorax, the elytra with almost obsolete tubercles, shorter legs, differently coloured scales, &c. Both the gentlemen named obtained numerous specimens.

TYCHREUS FASCICULATUS, n.sp.

Short, ovate, convex. Black; beneath piceous-black, claws reddish. Above, and the legs, densely covered with ashen—intermingled with brown—scales, which completely cover the shining derm, except the basal half of the prothoracic median line; on the undersurface the scales are sparse. Rostrum densely covered with elongate punctures; elytra striate-punctate, the punctures large but almost hidden; meso- and metasternum coarsely and densely punctate at the sides, sparsely punctate in the middle; abdominal segments with strong, elongate and rather sparse punctures; legs densely and minutely—the coxæ more strongly—punctate.

Prothorax trisinuate; the scales at the side of the median line with a reddish tint, a pale, oblique, rather indistinct line

on each side, then two oblique, small white spots; the sides broadly marked with whitish scales, edged immediately beneath with ochreous; three fascicles on each side of the median line, the basal small and dark, intermediate reddish and with a few short setæ, apical composed of elongate setæ, which slightly project over the head. Scutellum small, round. Elytra with a few whitish scales towards the apex, each with a number—about ten—of small irregularly placed, sparsely setose tubercles, and a large one about the middle—equidistant from each other and the sides—covered with long setæ, paler in the middle, darker and shorter at apex. Legs with irregular rings of whitish scales, and with whitish and brownish setæ; femora thick, keeled beneath, the keel terminating abruptly at a third from the apex; tibiæ flattened, arcuate (especially the intermediate), a short spur at their apices. Length 5, width $2\frac{2}{3}$ mm.

Hab.—Sydney.

I have but one specimen, and do not care to scrape it too much; where I have scraped off the scales on the elytra, the derm is seen to be shining, and covered with very minute punctures; the shining median line is very conspicuous.

CORYLOPHIDÆ.

This family appears to be numerous represented in Australia, although but two species have been hitherto described. Most of the following species were obtained during floods, others by searching decaying vegetable matter, and a few by beating drying boughs of Eucalypts and other plants. All of them have the prothorax strongly rounded in front and entirely covering the head; with a few of the species I have not been able to examine the head; in all that I have the eyes are coarsely faceted. They are all shining and slightly convex, a few moderately convex; in most of them the pubescence is of a yellowish colour, where it is otherwise I have specified it. The lengths given are those from apex of prothorax to apex of elytra; where I have had numerous specimens I have taken an average-sized one.

SERICODERUS MINUTUS, n.sp.

Broad. Testaceous; prothorax more clear than elytra, and with a piceous mark at its apex; undersurface somewhat darker than above; legs, muzzle and base of antennæ pale testaceous, rest of antennæ brown; abdominal segments slightly paler towards apex. Elytra with moderately long pubescence, slightly sparser on prothorax, undersurface densely clothed with rather short pubescence. Prothorax microscopically, elytra densely and minutely, underneath visibly punctate.

Prothorax with the base widely rounded, angles largely produced, acute. Scutellum slightly transverse, semicircularly triangular. Elytra at the base almost as wide as long, apex almost conjointly rounded. Femora somewhat thickened, distance between posterior greater than their length. Length $\frac{2}{3}$, width $\frac{2}{5}$ mm. (vix).

Hab.—Sydney, Galston, Forest Reefs, N.S.W.

SERICODERUS COMPACTUS, n.sp.

Very broad. Piceous, prothorax (except at apex, which is dark dull red) indistinctly lighter than elytra; muzzle, legs and antennæ pale testaceous. Above equally clothed with rather short greyish pubescence, undersurface more sparsely. Above with minute punctures, densest on elytra; metasternum minutely punctate.

Prothorax feebly depressed at base, bisinuate, angles largely produced, acute. Scutellum small, broadly transverse, semicircularly rounded. Elytra as wide as long, narrower than prothorax, narrowing from base to almost extreme apex, each feebly separately rounded. Femora moderate, distance between posterior less or equal to their length. Length $\frac{2}{3}$, width $\frac{2}{5}$ mm.

Hab.—Clarence River, N.S.W.

Differs from the preceding in being darker, broader, with a more transverse scutellum, and somewhat different pubescence.

SERICODERUS COATESI, n.sp.

Broad. Testaceous; prothorax more clear than elytra, and with a piceous mark at its apex; metasternum and basal segments of abdomen darker than above; legs, muzzle, palpi and base of antennæ pale testaceous, apical joints of antennæ infusate, abdominal segments edged with a paler colour. Above with rather sparse and not very long pubescence, sparsest and shortest on prothorax; undersurface rather more finely and densely pubescent. Prothorax microscopically, elytra densely and minutely punctate; undersurface indistinctly punctate.

Prothorax very feebly bisinuate at base, angles produced, acute. Scutellum as long as wide, semicircularly rounded. Elytra slightly longer than wide, each feebly separately rounded. Femora moderately thickened, distance between the posterior greater than their length. Length $\frac{4}{5}$, width $\frac{3}{5}$ (vix) mm.

Hab.—New South Wales: Inverell, Tweed River (Lea). Queensland: Brisbane (Mr. A. J. Coates).

The character of the scutellum, distinctly as long as wide, will separate this species from either of the preceding.

SERICODERUS OBESUS, n.sp.

Broad. Testaceous; elytra narrowly at base, prothorax narrowly at base and a small mark in front, piceous-black; undersurface darker than above; legs and base of antennæ pale testaceous, apical joints slightly darker. All over with moderately long pubescence, sparsest on prothorax and head. Above minutely, undersurface indistinctly punctate.

Prothorax with the base feebly rounded in the middle, angles produced and acute. Scutellum transversely triangular. Elytra wider than base, where they are wider than long, apex truncate. Femora thick. Length 1, width $\frac{2}{3}$ mm.

Hab.—Tamworth, N.S.W.

Differs from the preceding, which it strongly resembles, in being slightly larger and broader, angles of prothorax more strongly produced, scutellum slightly different, and by the dark marking of the suture of prothorax and elytra.

SERICODERUS INCONSPICUUS, n.sp.

Broad. Testaceous, with a piceous mark at apex of prothorax; metasternum somewhat darker than above; legs pale testaceous; antennae testaceous-brown, basal joints paler. Elytra with moderately long and rather dense pubescence, sparser and shorter on prothorax, beneath the pubescence is finer and somewhat denser. Prothorax microscopically, elytra densely and minutely punctate; on the undersurface the punctures are very indistinct.

Prothorax rounded and bisinuate at base, angles largely produced, acute. Scutellum moderately large, transverse, semicircularly rounded. Elytra slightly longer than wide, each separately rounded. Femora moderately thickened, distance between the posterior somewhat greater than their length. Length 1 (vix), width $\frac{2}{3}$ (vix) mm.

Hab.—Sydney.

Differs from *S. Coatesi* in being somewhat darker, slightly larger, a trifle more convex, and with a more transverse scutellum. This species closely resembles in shape and colour the European *S. lateralis* (for a specimen of which I am indebted to the Rev. T. Blackburn), but differs in being slightly broader, more feebly punctate, with somewhat denser pubescence, scutellum a trifle larger, and its prothoracic angles more acute.

SERICODERUS PICEUS, n.sp.

Broad. Piceous-brown, elytra somewhat darker than prothorax, undersurface coloured as elytra, apex of abdominal segments somewhat paler, legs and antennae pale testaceous, posterior legs darker. Above clothed with moderately long pubescence, sparsest on prothorax. Above sparsely and minutely, undersurface indistinctly punctate.

Prothorax bisinuate, angles moderately largely produced, acute. Scutellum broadly transverse, semicircularly rounded. Elytra longer than wide, decreasing in width from base to apex, each feebly separately rounded. Femora rather stout, distance between posterior less than their length. Length $\frac{4}{5}$, width $\frac{3}{5}$ mm.

Hab.—Clifton, N.S.W.

Of the same size and shape as *S. Coatesi*, but much darker, with longer pubescence, the scutellum smaller and much more transverse, and with less distance between posterior femora.

SERICODERUS HARDCASTLEI, n.sp.

Broad. Piceous-brown; prothorax (except an obscure mark at apex) somewhat paler than elytra; metasternum piceous, somewhat darker at the sides; muzzle and abdominal segments dark testaceous-red; legs and antennæ testaceous, the latter slightly infusate towards apex. Elytra with moderately long greyish pubescence, sparser on prothorax, abdominal segments more densely clothed with shorter pubescence, longer and sparser on metasternum. Prothorax sparsely and minutely, elytra more densely and strongly punctate, metasternum minutely punctate.

Prothorax bisinuate, broadly rounded in the middle of the base, angles largely produced, acute. Scutellum transverse, semicircularly rounded. Elytra longer than wide, narrowing from base to apex, each distinctly separately rounded. Femora not very thick, distance between posterior about equal to their length. Length $1\frac{1}{8}$, width $\frac{2}{3}$ mm.

Hab.—Sydney, Inverell, Forest Reefs, Tamworth (Lea); Armidale (Mr. D. McDonald); Hillgrove (Dr. C. Hardeastle).

SERICODERUS BASIPENNIS, n.sp.

Broad. Reddish-testaceous; prothorax with a piceous mark at apex, elytra rather more obscurely coloured than prothorax and scutellum, the base more or less broadly clouded with black; head (except muzzle), meso-, metasternum and basal segments of abdomen piceous-red; legs and antennæ pale testaceous, the latter slightly infusate towards apex. Above equally densely clothed with moderately long pubescence (shortest on prothorax), under-surface with rather longer and sparser pubescence. Above very minutely punctate (strongest on elytra), metasternum distinctly punctate.

Prothorax feebly depressed at base, bisinuate, angles largely produced, acute. Scutellum broadly transverse, semicircularly

rounded. Elytra as wide or slightly wider than long, each distinctly separately rounded. Femora moderately thickened, distance between posterior less than their length. Length 1, width $\frac{2}{3}$ mm.

Hab.—Windsor, Sydney, N.S.W.

The colour of the base of the elytra will at once distinguish this somewhat abundant species.

SERICODERUS APICALIS, n.sp.⁴

Broad. Testaceous above and below; prothorax with a piceous mark at apex (sometimes very indistinct); apex of elytra edged with black; head—except muzzle—brown; legs, palpi and base of antennæ pale testaceous, apical joints piceous. Elytra with rather long and not very dense pubescence, shorter but equally as dense on prothorax; undersurface—except head—as densely pubescent as above. Elytra densely and minutely punctate, on the undersurface the punctures are very indistinct.

Prothorax feebly depressed and rounded in the middle of base, angles largely produced, acute. Scutellum transverse, semi-circularly triangular. Elytra longer than wide, considerably wider at base than at apex, each distinctly separately rounded. Length $1\frac{1}{4}$, width $\frac{3}{4}$ mm.

Hab.—Sydney.

The colour of the apex of the elytra at once distinguishes this species.

SERICODERUS CONCOLOR, n.sp.

Broad. Reddish-testaceous, legs very slightly paler; antennæ brown at apex. Elytra with long and rather dense pubescence, prothorax sparsely clothed; on the undersurface (except abdominal segments) the pubescence is very fine. Elytra and undersurface densely and not very minutely punctate.

Prothorax bisinuate at base, base widely rounded in the middle, angles produced, acute. Scutellum widely transverse, semi-circularly rounded. Elytra longer than wide, apex conjointly rounded. Femora not very stout. Length $1\frac{2}{5}$, width $\frac{5}{6}$ mm.

Hab.—Richmond River, N.S.W.

Almost of the same bright colour as the preceding species, but without a trace of darker colour on prothorax or elytra.

SERICODERUS POLITUS, n.sp.

Very broad, moderately convex, highly polished. Dark piceous-brown; muzzle, legs and base of antennæ clouded-testaceous; anterior legs paler than four posterior. Above glabrous, under-surface moderately densely clothed with greyish pubescence. Above densely, extremely minutely and shallowly punctate; under-surface densely and minutely punctate, or very feebly transversely strigose.

Prothorax feebly bisinuate, angles produced, acute. Scutellum feebly transverse, semicircularly triangular. Elytra slightly wider than long, widest behind the base, slightly wider than prothorax, each separately rounded. Legs rather slender, distance between posterior femora less than their length. Length $\frac{5}{6}$, width $\frac{2}{3}$ mm.

Hab.—Windsor, N.S.W.

The convex form, glabrous upper surface and dark colour of this species will serve to distinguish it; the head is easily withdrawn from the prothorax. I have numerous specimens, but am not quite certain as to whether I have referred this species to its correct genus, or whether a new one should be formed for its reception.

CLYPEASTER COLLARIS, n.sp.

Moderately elongate. Reddish-testaceous; prothorax with a small piceous mark at apex, on each side of which is an indistinct pale testaceous marking, narrowly margined with piceous at base; head — except muzzle — blackish-brown; undersurface — except abdominal segments — darker than above, legs and antennæ testaceous. Above equally clothed with rather short and dense pubescence, undersurface rather sparsely pubescent. Above equally densely and not very minutely punctate, undersurface rather more feebly; underside of head minutely transversely strigose.

Prothorax feebly depressed at base, feebly bisinuate, angles not at all produced. Scutellum small, transversely triangular.

Elytra longer than wide, wider than prothorax, widest behind the base, apex conjointly rounded. Femora thick. Length $1\frac{1}{3}$, width $\frac{2}{3}$ mm.

Hab.—Richmond River.

CLYPEASTER PULCHELLA, n.sp.

Rather elongate. Prothorax bright red, with a piceous mark at its apex; elytra black, a broad bright red fascia across the middle, which is seemingly composed of two large semilunar spots having their convex sides towards the base, metasternum—except middle of apex—and sides of basal abdominal segment piceous-black, other segments piceous at sides, but decreasing to apex; head and antennæ brown. Elytra with rather short and sparse pubescence, still sparser and shorter on prothorax, undersurface with longer and sparser pubescence than above. Prothorax extremely minutely, elytra and metasternum very minutely punctate.

Prothorax shallowly bisinuate, angles scarcely produced. Scutellum transverse, semicircularly rounded. Elytra considerably longer than wide, widest behind the base and wider than prothorax, not much narrower near apex than at base, each separately rounded. Femora not very thick, distance between posterior greater than their length. Length $1\frac{1}{6}$, width $\frac{2}{5}$ (vix) mm.

Hab.—Sydney, Forest Reefs.

Easily recognisable by the red fascia on the elytra; *C. fasciatus* (from Tasmania) is described as having deep punctures on the elytra, and the legs differently coloured—characters not possessed by the present species.

CLYPEASTER ANDERSONI, n.sp.

Moderately elongate. Dark red; prothorax with an indistinct piceous mark at apex, base feebly tinged with piceous; elytra with a brownish blotch about scutellum; a piceous tinge at the junction of the meso- and metasternum and about all the coxæ; antennæ brown. Above equally clothed with not very long pubescence, the pubescence on the undersurface sparser and



rather longer. Prothorax with minute scattered punctures, elytra densely and minutely, metasternum feebly but distinctly punctate.

Prothorax rounded and feebly depressed at base, angles slightly produced. Scutellum slightly longer than wide, semicircularly rounded. Elytra considerably longer than wide, widest behind the base, and slightly wider than prothorax, each feebly separately rounded. Femora not very thick; distance between posterior more than their length. Length $1\frac{1}{4}$, width $\frac{3}{4}$ (vix) mm.

Hab — Clarence River.

Differs from *C. collaris* in being larger, in having the punctures on the prothorax stronger but less dense, its base somewhat different, and by the blotch about the scutellum. I have dedicated the species to Mr. H. C. L. Anderson, formerly Director of the New South Wales Department of Agriculture.

CLYPEASTER DORSALIS, n. sp.

Moderately elongate. Red; prothorax with a piceous mark at apex, elytra with a brownish blotch about scutellum, the apex piceous, the extreme apex lighter; metasternum darker than above, muzzle and legs reddish-testaceous, apical joints of antennæ piceous-brown. Above with moderately long and not dense pubescence, sparse on prothorax, sparser on the undersurface. Above very densely and extremely minutely punctate, and with minute scattered punctures; metasternum visibly punctate.

Prothorax feebly depressed and almost truncate at base, angles very slightly produced. Scutellum rather small, feebly transverse, semicircularly rounded. Elytra longer than wide, widest behind the base, and slightly wider than prothorax, each separately rounded. Femora rather thick, distance between the posterior greater than their length. Length 1, width $\frac{1}{2}$ mm.

Hab.—Tweed River, N.S.W.

Differs from *C. collaris* in being smaller, by the dark markings of the elytra, prothoracic punctures much sparser and feebler, and its base somewhat different; in this last respect it resembles the preceding, but its much sparser puncturation and smaller size will distinguish it from that species.

CLYPEASTER BLACKMOREI, n.sp.

Elongate. Piceous; sides of apex of prothorax obscure red; suture and apex of elytra obscure dark red; abdominal segments paler than metasternum; the legs reddish-testaceous; antennæ brownish-testaceous, basal joints and the muzzle somewhat paler. Above with rather sparse and moderately long pubescence, on the undersurface the pubescence is still sparser, but rather longer. Above moderately densely and rather minutely, metasternum distinctly, punctate.

Prothorax very shallowly bisinuate, angles very feebly produced. Scutellum small, longer than wide, semicircularly triangular. Elytra much longer than wide, widest behind the base, where it is slightly wider than prothorax, not much wider at base than near apex, each distinctly separately rounded. Femora moderate, distance between the posterior greater than their length. Length $1\frac{1}{3}$ (vix), width $\frac{2}{3}$ mm.

Hab.—Galston, Forest Reefs.

CLYPEASTER NITIDA, n.sp.

Moderately elongate. Piceous-brown; sides of apex of prothorax obscure pale testaceous; suture and sides of elytra indistinctly paler than disk; undersurface somewhat darker than above, tibiæ and tarsi paler than femora; antennæ obscure testaceous, apical joints feebly infusate. Above almost glabrous, the pubescence being very short, sparse and dark; undersurface with moderately long and dense pubescence, longest down the middle of metasternum. Above with moderately dense and not very minute punctures, undersurface densely and extremely minutely punctate, metasternum with large shallow punctures.

Prothorax feebly depressed in the middle of the base, very shallowly bisinuate, angles very feebly produced. Scutellum broadly transverse, semicircularly rounded. Elytra considerably longer than wide, widest behind the base, slightly wider than prothorax, base scarcely wider than apex, apex almost conjointly

rounded. Femora moderate, distance between posterior about equal to their length. Length 1, width $\frac{3}{4}$ (vix) mm.

Hab.—Sydney.

Differs from the preceding in being broader and more convex, in its different puncturation and pubescence, and its differently shaped scutellum.

CLYPEASTER OLLIFFI, n.sp.

Moderately elongate. Piceous-brown; prothorax at the sides in front narrowly pale testaceous, or obscurely semitransparent; undersurface darker than above, legs and antennæ testaceous, the latter slightly infusate towards apex. Above almost glabrous, the pubescence being extremely short and sparse, undersurface rather more densely but still sparsely clothed. Above very densely and extremely minutely punctate, and with moderately dense shallow punctures; metasternum indistinctly punctate.

Prothorax feebly depressed at base, very feebly if at all bisinuate, angles not produced. Scutellum transverse, semicircularly triangular. Elytra longer than wide, wider than prothorax, widest at the middle, as wide near apex as at base, each separately rounded. Femora not very thick, distance between posterior slightly greater than their length. Length $\frac{5}{6}$, width $\frac{1}{2}$ mm.

Hab.—Windsor, Sydney, Tamworth.

The peculiar puncturation of this rather plentiful species renders it very distinct.

CLYPEASTER SQUALIDA, n.sp.

Moderately elongate. Piceous-brown; elytra obscurely piceous at apex and sides; a piceous mark at apex of prothorax, on each side of which is a small semitransparent obscure testaceous mark; legs, muzzle and antennæ testaceous; antennæ infusate towards apex. Above equally clothed with rather short greyish pubescence, the pubescence on the undersurface as dense but somewhat finer. Above minutely and not densely, metasternum minutely punctate.

Prothorax very narrowly depressed at base, shallowly bisinuate, angles slightly produced. Scutellum feebly transverse, semicircularly triangular. Elytra longer than wide, slightly wider

than prothorax, widest near the middle, feebly separately rounded. Femora moderate, the distance at their bases equal to or slightly greater than their length. Length 1 (vix) width $\frac{1}{2}$ mm.

Hab.—Sydney.

Very similar in size, shape and colour to the preceding, but differing in its puncturation, which closely resembles that of *C. Andersoni*, but is otherwise distinct.

CLYPEASTER ELLIPTICA, n.sp.

Elongate, moderately convex. Prothorax red, a piceous mark at apex; elytra piceous-black, with an indistinct dark red mark at the apex, and very indistinct near the sides; undersurface dark red, the metasternum piceous, legs and antennæ—which are concolorous—bright red, posterior femora somewhat darker. Elytra clothed with rather long pubescence, as dense but somewhat shorter on prothorax; the pubescence on the undersurface sparser, finer and darker than above. Elytra densely and extremely minutely punctate, and with small moderately dense punctures (sparsest on prothorax), metasternum minutely punctate.

Prothorax feebly depressed in the middle of the base, shallowly bisinuate, angles scarcely produced. Scutellum feebly transverse, semicircularly triangular. Elytra much longer than wide, widest behind the base, where it is slightly wider than prothorax, not much wider at base than near apex, each separately rounded. Femora moderate, distance between posterior about equal to their length. Length $1\frac{3}{5}$, width 1 mm.

Hab.—Clarence and Richmond Rivers, N.S.W.

This is a very distinct and rather rare species, much larger than any as yet recorded from Australia.

ON TWO NEW GENERA AND SPECIES OF FISHES FROM AUSTRALIA.

By J. DOUGLAS OGILBY.

(Communicated by the Secretary).

PERCOPHIDÆ.

CENTROPERCIS, gen.nov.

Branchiostegals(?) five; pseudobranchiæ present. Body elongate-oblong, compressed; head conical; cleft of mouth wide and moderately oblique; lower jaw the longer; eye lateral, partially directed upwards; gill-openings wide; gill-rakers stout, of moderate length, few in number; bones of head armed or radiate. Jaws, vomer and hyoid bones with well-developed, fixed teeth; palatine and pterygoid bones edentulous. Two dorsal fins, the first with six spines; the second more developed, similar to the anal; no semi-detached spines in front of the anal; ventrals thoracic; all the pectoral rays branched. Scales small, poriferous, those of the head cycloid, of the body ctenoid; body with regularly arranged series of naked bands.

CENTROPERCIS NUDIVITTIS, sp.nov.

B. v. (?) D. 6 $\frac{1}{20}$. A. $\frac{1}{17}$. V. $\frac{1}{5}$. P. 13. C. 15.

Length of head four and one-third, height of body six and one-fourth in the total length; width of head two-thirds of its height and two-fifths of its length. Diameter of eye four and two-fifths in the length of the head: premaxilla trilobate, snout emarginate, in front; the latter a little longer than the diameter of the eye; interorbital space grooved, three-fifths of the diameter

of the eye. Nostrils simple, lateral, situated at the opposite ends of a shallow fossa. Lower jaw the longer; cleft of mouth wide and moderately oblique; the maxilla truncated and expanded posteriorly, extending backwards beyond the hinder margin of the eye; upper profile of head flat. Preorbital armed with three strong spines; preopercle finely denticulated on both limbs, and with a strong, acute, elongate, curved spine at the angle; three short stout spines on the subopercle; opercle and interopercle with prominent ribs, each of which terminates in a free flexible point; a spinose ridge runs from the front of the snout to the postero-superior angle of the orbit, where it is subdivided, a short branch passing downwards along the upper portion of the hinder margin of the eye, while the main branch is continued along the occiput; beneath the termination of the latter a similar ridge commences, and traversing the temporal region ends in a pair of strong post-temporal spines; a short spinose ridge on the occiput below the middle of the occipital ridge; a short simple ridge passes outwards from the centre of the posterior margin of the eye. Jaws with a single series of slender cordiform teeth, those in front being strongly hooked; two or three smaller teeth between each pair of elongate ones; three strong and a few small teeth on either side of the head of the vomer; two short parallel patches, composed of three series each, of stout recurved teeth behind the base of the tongue, the outer row the strongest; all the bones of the hyoid arch dentiferous. Dorsal fins separated by a considerable interspace; the spines weak and flexible, the second the highest, two-fifths of the length of the head, and two-thirds of the anterior and highest rays: the anal commences beneath the third dorsal ray, and is similar to but not so high as the soft dorsal fin: ventral elongate and pointed, the fourth ray the longest, reaching to the vent, its length three-fourths of that of the head: pectoral small, about half the length of the ventral, its base situated at a considerable distance behind that of the ventral: caudal emarginate, small, its length six and a half in the total length. Scales of the head simple, circular, non-imbricate, each furnished with a central pore; head entirely scaly, with the excep-

tion of the posterior third of the opercle and the greater part of the subopercle, the scales on the latter being arranged in a narrow basal band on its upper half, from the extremities of which short, broad bands are produced backwards; below this there is a free angular band; scales of body similar to those of the head, but strongly ctenoid; eighteen enlarged tubular scales on the lateral line, with from six to eight normal scales in the space between each pair; between each tubular scale and the base of the dorsal there is a naked band about two normal scales in width, which is continued across the lateral line to the depth of two scales; sides of abdomen and base of the anal fin with more or less corresponding naked fasciæ. Upper surface of head and body olive-green, lower surface pale yellowish-white, the two colours being abruptly divided; a series of seven olive-green spots along the middle of the sides, the last encircling an enlarged tubular scale at the base of the caudal; fins immaculate.

The unique specimen from which the above diagnosis has been drawn up was washed ashore, in a perfect though dying condition, at Maroubra Bay, near Sydney, and was shortly afterwards lent to me by its discoverer, Mr. Thomas Whitelegge, for identification and, if necessary, description. In length the type specimen measures 78 millimètres, and it has since been added to the collection of the Australian Museum, Sydney, its register number being I. 3396.

ATHERINIDÆ.

TROPIDOSTETHUS, gen. nov.

Branchiostegals six; pseudobranchiæ present. Body strongly compressed, rhombo-fusiform, the tail attenuated; dorsal profile straight, ventral convex and acute. Cleft of mouth oblique, extending to beneath the front margin of the eyes; jaws not protractile. A single series of teeth in the jaws and a short curved row on the palatine bones; no vomerine or lingual teeth. Spinous dorsal small; anal moderate; ventrals minute, situated far behind the pectorals. Scales of moderate size, thin, cycloid, deciduous.

TROPIDOSTETHUS RHOTHOPHILUS, sp. nov.

B. vi. D. 4. 1/15. A. 1/23. V. 1/5. P. 14. C. 17. Vert. 15/29.

Length of head five to five and a half, height of body five in the total length. Eye situated near to the dorsal profile, its diameter three to three and a half in the length of the head, and four-fifths of the flattened interorbital space; snout obtuse and convex, rather less than the diameter of the eye in length; the upper jaw slightly projecting. Spinous dorsal situated above the vent, and midway between the tip of the snout and the base of the caudal fin; soft dorsal commencing above the anterior third of the anal; caudal forked, its length six and three-fifths to six and three-fourths in the total.

- General colour gray (pale straw-yellow in spirits), so closely dotted with minute brown specks as to give it a brownish appearance when newly caught; a broad silvery lateral band, margined above by an emerald streak; the ventral edge faintly tinged with green. Occiput with a large cuneiform emerald spot, the acute portion extending forwards between the eyes; a brown spot contained within its anterior half; nostrils pierced in an emerald spot; supraorbital region tinged with pale green.

These little Atherinids were first observed by Mr. Thomas Whitelegge at Maroubra Bay* during the month of March, 1893, but the specimens which he brought back to the Museum, being considered immature, were not critically examined on that occasion. Their reappearance, however, in large shoals along the coast during March of the present year induced us to investigate more closely their habits, mode of life, and such other points in their economy as could be observed; this difficult task has been ably carried out by Mr. Whitelegge, with the result that though the shoals have been on the coast from March until the date of writing—July 31st—there is no appreciable difference in size,

* Between Port Jackson and Botany Heads.

thus proving, what from a prior examination we had inferred, that the fishes are adult; no signs of breeding have, however, as yet been discovered.

They are essentially surf-fishes, coming in with the waves, and being swept up into the gulches and pools on the reefs; they never descend to the bottom, but swim here and there, keeping but a few inches beneath the surface; the pectoral fins are always kept fully expanded, at right angles to the body, and motionless, being utilised in fact solely as balancing media; the caudal fin and pedicle have a distinct downward curvature when the fish is swimming.

LIFE-HISTORIES OF AUSTRALIAN COLEOPTERA.

PART III.

BY WALTER W. FROGGATT.

This paper contains my contribution to the study of the habits of our Coleoptera for the season 1894-5, and is really a continuation of previous notes on this subject; for the observations of one year run into the next, and some of the insects have to be watched for over twelve months before the larva can be correlated with the perfect insect.

As before, I am indebted to the Rev. Thos. Blackburn for the determination of some of my beetles, and to Mr. R. T. Baker for the verification of the botanical names of some of their food plants.

APHANASIVM AUSTRALE, Boisd.

Larva short and stout, pale yellow, with well-defined abdominal segments; jaws black, and truncated at the tips, mouth parts raised upon a slightly lobed projection, the basal portion of the head forming an encircling fold, slightly overhanging in front; on the lower edge of the forehead are four irregular yellow patches; thoracic segments narrow, legs small, short, ferruginous; on the dorsal surface the first five segments flattened, of regular size, produced into an elongate oval, slightly impressed in the centre, with a patch of reddish-brown hairs on either side, 6th and 7th rather larger and rounder, 8th small, 9th also short, terminating in a short obtuse point; on the ventral side the segments are comparatively flat.

The larvæ feed upon the stems of *Hakea acicularis*, growing in the neighbourhood of Sydney, a number always boring into the shrub at one place, causing the branches to wither and snap off; perhaps nearly a dozen grubs will feed in a single branch gnawing

out parallel chambers, but never breaking into each other's mine. The dying foliage is noticeable early in January, their attacks causing the limb to become swollen and covered with exudations of gum. The beetles come forth in the first week in November; I have never taken the beetle at large, but it is evidently common on this shrub at certain seasons of the year, though very effectually concealed in the dense prickly foliage. The beetle is 10 lines to an inch in length, with very large prominent eyes and long slender antennæ; thorax finely rugose, produced into a stout blunt spine on either side; elytra rounded at the shoulders, of a uniform width to the tips, which are round, not quite covering the tip of the abdomen; the whole insect is of a uniform chestnut-brown, the central portion of the wing covers being much lighter than the edges, and the whole of them covered with close, fine, fawn-coloured down.

Hab.—The neighbourhood of Sydney.

STRONGYLURUS THORACICUS, Hope.

Larva dirty white, with rather large head, armed with stout black jaws, broad at the tips; body short and corrugated. Dorsal view: forehead large, flattened, projecting slightly in front, creamy-white with a large blotch of bright yellow on either side, covered with stout reddish hairs; thoracic segments narrower than the head; first four abdominal segments bearing two corrugated lobes on the summit; the 5th, 6th and 7th with two rounded tubercles divided in the centre; all the segments distinctly divided from each other at the apical margins; the last two segments rounded. Ventral view: thoracic segments much flattened, legs very small, short and ferruginous, the margins of all the segments fringed with fine hairs.

The larvæ attack the stems of the common garden Pittosporums (*P. revolutum* and *P. undulatum*) growing in suburban gardens. In the neighbourhood of Croydon, where most of my specimens were obtained, they completely disfigured a large shrub of the former species, large branches three and four inches in diameter being cut off; over a dozen of the lower limbs fell during last

season, while little streams of dust could be seen falling from the holes where they had gnawed through the bark; most of the fallen branches are hollowed out before they break off, but the larva nearly always remains behind in the stump of the branch feeding into the green wood, which dies down below where it pupates. They take some time to reach maturity, certainly not before the second year, as I have kept larvæ over that time without any sign of their pupating.

Mr. Geo. Masters tells me that at Elizabeth Bay, *Symphyletes nigro-virens* feeds upon the garden Pittosporums; while *Strongylurus thoracicus* confines its attacks to the white cedar (*Melia composita*), cutting off the branches in exactly the same manner.

The beetle is 10 lines in length, with dark brown head clothed with coarse brown hairs, an elongate spot of silvery white hairs between the eyes; antennæ toothed on the outer apical margin of each joint; thorax dark reddish-brown, deeply and coarsely punctured, with three large round patches of white hairs on either side, with another smaller one in front of the scutellum; elytra ferruginous on the shoulders, paler towards the tips, deeply punctured for about two-thirds of their length, but almost smooth towards the apex; a row of 4 small black spots across the shoulders, with an irregular black horseshoe-like band on either side; the tips of the wing covers and the apical margins black; the whole of the upper surface clothed with scattered grey down; underside clothed with greyish hairs, with a patch of white hairs forming an oval mark on the side of each segment.

The larvæ were most active in the early summer months after the new year, the beetles breeding out early in December.

ATERPUS CULTRATUS, Fabr.

Larva 5 lines in length, short, and obese, lying with its back arched and the tip of the abdomen curved towards the head; dull white, with dark chocolate-brown head, truncate at the base, mouth parts rather prominent, and with a median groove lightly impressed down the centre of the head; a dark brown transverse line in front of the first thoracic segment; on the dorsal surface

the segments are of uniform size, each forming a double fold at the apex, and divided into three distinct lumps or warts on either side, the ventral surface flat, with a fringe of long reddish hairs along the marginal folds of each segment.

The larvæ feed upon the stem of *Melaleuca stellatum*, commencing on the bark and then gnawing out an elongate oval cavity in the side of the branch underneath the loose bark; in this cavity they form a rough rounded cocoon of gnawed wood early in July. The infested stems were cut off, and in captivity the beetles bred out early in September. They were very plentiful at Rose Bay (Sydney).

Two years ago I bred a single specimen taken at Manly, which had formed a similar pupa case on the stem of *Eucalyptus corymbosa*. The beetle is generally found upon small gum trees, and often comes to the stump of a freshly cut down tree, probably for the exuded sap.

It is 5 lines in length; head, legs, and apical portion of elytron chocolate-brown; thorax black, deeply and regularly punctured, with a stiff brush of black down on either side towards the head; the basal portion of the wing covers black, regularly and deeply striated, with the punctures in regular rows; carrying a double pair of tufts of black down on each shoulder, with a corresponding single one on either side towards the apex, where the elytron slopes down with deep regular striations towards the tip, and is ornamented with two much smaller black tufts.

This beetle has a wide range over Australia, and is a rather common weevil about Sydney.

EURHYNCHUS LÆVIOR, Kirby.

Larva 10 lines in length, slender and of uniform length, rounded on the dorsal surface; of a dull yellow colour; head almost spherical, flattened in front, deep reddish-brown, slightly rugose, fringed in front with a few scattered long hairs; jaws black, truncate at the tips, palpi very short, and the labrum very small and wedge-shaped; thorax with 1st segment ochreous-yellow, smooth and shining, 2nd and 3rd pale yellow, covered on the

summit with a patch of very fine reddish spines; on the ventral surface flattened and corrugated, each bearing a pair of very short conical legs : abdominal segments slightly smaller than the thorax, corrugated and clothed with similar fine spines as the thoracic segments.

The larvæ feed upon the stems of *Persoonia lanceolata*; entering through the bark a few inches above the surface of the ground, they bore holes towards the centre of the trunk, then turning upwards and hollowing out parallel chambers several inches long, and pupating at the end of the last chamber. I found one nearly perfect beetle, and several full-grown larvæ early in July, at Hornsby. The beetle is about 7 lines in length, of a general slender and very graceful form compared with most of the weevils; black, but having a greyish tint from the fine clothing of grey hairs covering both dorsal and ventral sides. The snout is long, slender, and smooth, the thorax rugose, the elytra also rugose, with close deeply punctured striae.

It is not a very common beetle, but is generally found in pairs, about November, clinging to the twigs of small bushes.

AXIDES DORSALIS, Pascoe.

Larva pale yellow, about $3\frac{1}{2}$ lines in length when uncurled; when met with is nearly always lying with its back arched and the head nearly touching the tip of the abdomen; head oval, ferruginous, with two pale ochreous lines in the centre giving it a variegated appearance; jaws black, short, and angular; first thoracic segment small, 2nd and 3rd with the first seven abdominal segments of a uniform size; 8th and 9th forming a short broadly rounded tip.

The larvæ are very plentiful in May and June in the stems of *Astrotricha floccosa*; they bore from the surface into the soft pithy centre, forming short cylindrical burrows, sometimes only one or two being together, but oftener in little colonies of ten or a dozen; their attacks cause the limb to swell and exude a lot of sticky strongly smelling aromatic resin, which burns very readily;

this, together with the castings, forming irregular excrescences upon the branches.

The beetle is $2\frac{3}{4}$ lines in length, of a general creamy buff colour, due to a dense growth of fine hairs covering the dark chocolate coloured elytra, the natural colour visible only on the snout; the centre of the thorax and from the shoulders for about two-thirds of the back pale reddish-brown, thickly interspersed with fine black spines or bristles commencing on the thorax, and increasing in number towards the middle of the elytra, where they form a dark patch. The thorax is further ornamented with two pairs of small downy plumes on the sides, and the elytra are broadly impressed with coarsely punctured striae.

The beetle is found at large upon its food plant early in November; most of my specimens were obtained on a large patch of the bushes at the head of the Double Bay Valley.

DOTICUS PESTILENS, Olliff.

Larva 2 to $2\frac{1}{2}$ lines in length; pale yellow, with the apical portion of the abdomen slightly ferruginous; head small and orbicular, partly hidden by the thorax; jaws small, with the tips divided into two pointed teeth, with a larger and more angular one on the inner edge; segments rounded, the abdominal ones forming a double fold along the sides, the under fold smallest, tip of the abdomen curled inwards, and the whole larva clothed with long hairs.

The larvæ feed in the interior of lumpy reddish-brown galls, produced in the first instance, I think, by the attacks of lepidopterous larvæ, upon the tips of the branchlets of *Acacia decurrens*; the galls or rather after-growths upon the twigs become dead and dry up in February; and at this season nearly every gall is tenanted with a little grub, covered with woody dust.

The beetle, about 3 lines in length, dark brown in colour and covered with greyish down, was found in the box containing the galls about a week after they were collected. It has a peculiar way of jumping when touched.

The life-history of this beetle is of importance, as the insect is a well-known orchard pest. The species was described by Mr. A. Sidney Olliff from specimens received from Mr. C. French; they had attacked the apples near Melbourne, and by puncturing them caused them to shrivel up before they were ripe.

Mr. French has given an account of this pest and its ravages, with a plate containing figures of it in all stages, in his Handbook of the Destructive Insects of Victoria* under the name of *Doticus pestilens*, the apple beetle.

Hab.—Heathcote.

MÆCHIDIUS RUGOSUS.

The description of the larva of the previous species will serve also for this, except that it is slightly larger when full grown. The larvæ live in the thick bark of *Eucalyptus robusta*, where they pupate; the beetle comes out in September and October, and will be found in crevices, or under loose bark on the trunks of the trees.

This beetle is slightly larger than *M. tibialis*, having the same uniform coloration; the flanges in front of the head more angular, with the edges curved upward, and the back of the head and thorax very finely and closely punctured, so that the outer edges have a fine serrate appearance; the elytra covered with fine close deeply punctured parallel striæ; the whole of the dorsal surface covered with very minute scale-like hairs scattered over the head and thorax; on the elytra forming regular lines along the ridges of the parallel striæ.

Hab.—Botany, N.S.W.

MÆCHIDIUS TIBIALIS, Blackburn.

Larva dirty white, rather long and slender, the head pale yellow, with short ochreous-yellow labrum, and stout short jaws of the same colour; thoracic segment more constricted than the first abdominal segments; legs short, covered with short golden

* Part I. Chap. xiii. p. 83.

yellow hairs, which are also sparsely scattered along the sides of the body; tarsal claw black, small and sharply pointed; all the segments along the dorsal surface except the last two covered along the summit with short brownish spines.

The larvæ, together with the perfect beetles, were found in the nests of the large mound-building Termite; they were very numerous in several nests opened, most of the larvæ being in the outer walls, but others were in the interior of the nest, while the beetles were crawling about all parts of the termitarium, the swarming hosts of white ants seeming to take no notice of them.

The beetle is $4\frac{1}{2}$ lines in length, dark brownish-black, with the head produced into two shell-like flanges in front of the eyes; thorax finely punctured; elytra traversed with deeply and closely punctured parallel striæ.

Hab.—Shoalhaven, N.S.W.

MELOBASIS IRIDESCENS, L. & G.

Larva white, slender and flattened on the underside; jaws small; head globular, much broader than the thoracic segments; pale yellow, with two ferruginous lines crossing the head and coming to a point at the forehead; first and second thoracic segments rounded and narrow; third thoracic and the first six abdominal segments rounded on the margins, but square at the apex, which projects over the following segment on either side; seventh and eighth much smaller, while the anal segment is produced in a curious forked tail, divided into a rounded lobe at the base, terminating in a slender tail on either side.

The larva feeding between the bark and sapwood forms a series of parallel wavy tunnels in wood that is just beginning to wither; when nearly full grown it bores in the sapwood to pupate.

The beetle is about 4 lines in length, of a bright metallic green colour, with the head and thorax very finely punctured; elytra irregularly striated, with the striæ bearing punctures; with the ridges between them also punctured; apical edges of the wing covers very finely toothed. Bred from infested branches of *Acacia longifolia* obtained at Rose Bay.

M. iridescens is given in Masters' Catalogue as a variety of *M. cupriceps*, but it is very distinct both in form and habits from the beetles determined by Mr. Blackburn as the latter.

M. cupriceps is nearly a third longer, of a more delicate pale green colour, with decided golden tints upon the shoulders, and it is more boat-shaped upon the back, with the serrate edges of the elytra very deep and slender. The abdominal striae are very fine and regular, and sparingly punctured, while the spaces between them are perfectly smooth.

This beetle is rather common about Sydney, feeding upon the foliage of *Viminaria denudata* early in the year; but I have never taken *M. cupriceps* on an Acacia.

MELOBASIS SPLENDIDA, DONOV.

I have not been able to identify the larva of this beautiful little Buprestid; but in chopping the dead stems of *Acacia longifolia* I have come upon several fully developed in an irregular chamber at the end of a tunnel leading from under the bark into the sapwood; and have bred as many more from infested wood kept in boxes.

The beetle is 4 lines in length, bright metallic-green, with two parallel bands of dark purple across the thorax; and a brilliant fiery coppery-red pattern formed by two bands commencing behind the thoracic bands, leaving a bright green patch round the pronotum and joining just below, occupying all the centre of the back, and after projecting out on either side into two sharp angles, runs round the tip of the wing covers, and forms a narrow stripe along the apical part of the margins not quite up to the hind legs; all the underside is bright green.

Hab.—Rose Bay, N.S.W.

CISSEIS MACULATA, L. & G.

A score of specimens of this beetle have been bred, in October, from dead branches of *Acacia longifolia* collected at Rose Bay, and kept in closed boxes; others were obtained in November and December, feeding on the leaves of the same Acacia at Manly.

The beetle is about 3 lines in length, the front of the head bright green, the thorax and shoulders bright metallic-bronze, the centre of the wing covers black with metallic reflections, and the tips fiery red colour. Underside of thorax and legs green, with the abdominal segments bronzy-red.

CISSEIS SEMI-SCABROSA, L. & G.

Larva very pale yellow, with small mouth parts and jaws; head large and globular; 1st and 2nd thoracic segments small, rounded on the edges; the 3rd thoracic and the first six abdominal segments more or less rounded on their extremities, the last three tapering to a small rounded tip.

It feeds in a very similar manner to that of *Melobasis iridescens*; at first under the bark, but finally pupating in the sapwood beneath.

The beetle is $4\frac{1}{2}$ lines in length, the head and thorax bright metallic-green; the elytra fiery coppery-red and finely granulated, all the underside green.

This is not a common species; I have bred three individuals from infested branches of *Acacia longifolia* obtained at Rose Bay.

CADMUS FLAVOCINCTUS, Saund., Trans. Ent. Soc. 1846.

Larva 4 lines in length, pale yellow, with a cylindrical black rugose head, truncate and perfectly flat in front, with short 3-jointed antennæ projecting on either side and the jaws almost hidden; 1st thoracic segment covered on the dorsal side with a dark brown coriaceous plate slightly curved in front; legs very long, slender, armed with a sharp tarsal claw; the rest of the segments of uniform size, pale yellow, clothed on the sides with long scattered hairs, thickest towards the tip of the abdomen, the legs also covered with long hairs.

The larva constructs an elongate oval cocoon with a jug-like neck, of a stout woody nature, smooth, hard, and dark brown; the grub by protruding its head and fore legs can crawl about on the ground, or among the loose bits of dead bark at the butts of the gum trees in a similar manner to the case moths; but from the

remarkable resemblance of these cocoons, when in a quiescent state, to the castings of some of the large wood-eating lamellicorn beetles, they are very easily passed over.

When the larva is full grown it forms a concave lid over the top of the opening, and remains on the ground generally under logs or fallen timber until it is ready to emerge.

Like nearly all the members of this genus the beetles feed upon the foliage of the young Eucalypts.

The beetle is about 4 lines in length, reddish chocolate-brown, with irregular black blotches upon the thorax and upper half of the elytra; thorax and wing cases very rugose, the former very finely punctured; the latter deeply ribbed with parallel striae, closely and finely punctured.

Hab.—Not common in the neighbourhood of Sydney, but plentiful in the Shoalhaven District.

EPILACHNA 26-PUNCTATA, Dejean.

Eggs pale yellow, placed in patches of thirty or forty upon the underside of the leaves; elongated and pointed at the apex; having a beautiful granulated appearance under the lens. The larva on emergence and after each moult pale yellow.

Larva short and stout, 5 lines in length and 3 in breadth, pale yellow. Dorsal view: head completely hidden by the folds of the thorax; 1st thoracic segment covered with a blackish patch from which spring up four black spines, each of them with several finer radiating spines growing from their sides; white at the tips; 2nd and third thoracic segments with a blackish patch on either side, with two similar feathery spines springing out from them; with another black patch on either side just above the legs out of which a single feathered spine grows; the following six abdominal segments have a double feathered spine in the patch on the centre of the back, with two smaller blotches on either side, each producing a spine, 7th abdominal segment bearing 4 spines, the 8th and anal one two.

Ventral side: pale yellow; head small, black and rounded behind, elongated towards the jaws, which are short and toothed:

palpi long and drooping; legs stout, long and mottled with black; the inner edge of the tarsi fringed with fine white hairs; tarsal claws ferruginous, the central ridge of the abdominal segments marked with a line of small blackish brown spots.

The larva attaches itself to the underside of the leaf, when the larval skin splits and turns down over the pupa, remaining in this position about ten days.

This is one of the commonest ladybirds about Sydney. Both beetle and larva feed upon the leaves of Solanaceous plants, gnawing the epidermis off in little wavy lines, causing dead patches all over the leaves. They were also very plentiful upon the leaves of *Datura stramonium*, on the seashore at Botany; a number that I took home were let out of the box, and a few days later they were busy at work eating the leaves of the tomato plants.

It is a handsome little beetle of a deep yellow colour mottled with irregular black spots; all the members of this genus, unlike others of the family, are phytophagous.

In "Insect Life," 1891, Vol. iii. *Epilachna corrupta* is stated to have destroyed fully half the bean crop of New Mexico.

An African species, *E. hirta*, is very destructive to potatoes and tomatoes.

A GIANT ACACIA FROM THE BRUNSWICK RIVER.

BY J. H. MAIDEN, F.L.S.

(Plate XXI.)

ACACIA BAKERI, sp.nov.

Attains the dimensions of a large forest tree, measuring up to 160* feet in height, and from 2 to $4\frac{1}{2}$ feet in diameter; stem sometimes buttressed. It is, as far as at present known, exclusively confined to brushes, as distinct from open forest. Branchlets at first terete but at length flattened, glabrous. Phyllodia sessile, broadly lanceolate, narrowed at each end, obtuse, mostly 3 to 4 inches long and 1 inch broad, but occasionally 6 inches long and 3 inches broad when they are acuminate and broad at the base; 3-nerved, with sometimes a short one terminating in a gland a little removed from the base, penniveined between the nerves, margins thickened and undulate, thinly coriaceous. Peduncles slender, 6 lines long, mostly in clusters of 3 to 10, forming numerous axillary racemes mostly exceeding the phyllodes, bearing a small loose head of few, pale coloured flowers, rarely as many as 20, mostly 4-merous. Calyx short, pubescent or softly villous, eventually separating into spathulate lobes. Petals pubescent, softly villous. Pod long, straight, flat, usually 8 inches long and 6 lines broad, thin, contracted somewhat between the seeds, shining. Seeds flat, ovate, longitudinal; funicle short and filiform, neither folded nor enlarged.

* A road party recently cut down one of these trees on Mullumbimby Creek, and it was found by measurement to be 140 feet high, and 3 feet 8 inches in diameter. The collector adds "On Tengoggin Mountain there are *plenty* of trees 20 or 30 feet higher."

Hab.—Tengoggin Mt. (1000 ft.), near Mullumbimby, Brunswick River, N.S.W.; also Mullumbimby Creek, a tributary of the Brunswick (W. Bäuerlen).

According to Bentham's classification this *Acacia* belongs to the series *Plurinerves*, sub-section *Dimidiatae*.

This is probably one of the largest of all the *Acacias*. It has been found in the Mountains measuring over 160 feet, with a trunk from 50-60 feet clear of limbs, and a diameter from 2 to 4 feet, and on the banks of creeks 140 feet high, and in some instances "so high that the leaves could not be seen" (distinguished).

The flowers are small, in loose racemes with fairly long peduncles. Branches pendulous. Phyllodes vertically flattened and also twisted towards the base, thin, quite glabrous. The pods are very difficult to procure owing to their ripening and falling in what is usually the wettest part of the year. In many instances pods were caught while falling from the trees when every seed was found to have begun to germinate.

They are very variable both in length and breadth, some being very broad and a little constricted between the seeds, while others from the same tree are very narrow and much constricted, the valves are all very thin.

The bark is quite distinct from *A. binervata*, its nearest ally. It is inclined to be smooth and exudes very little gum, as far as seen, and is reputed to be poor in tannin.

The timber is pale coloured right to the heart, as far as seen. It will be described subsequently.

The flowers, bark, seeds and timber all emit an alliaceous odour when fresh, reminding one of *Dysoxylon rufum*.

Its closest affinity is with *A. binervata*, which it resembles in the penniveined reticulations of the phyllodes and in the flowering racemes, but differs from it in individual flowers, pod and seed.

It ranks with *A. excelsa* in size and the shape of the seed and aril, but differs in the nervation of phyllodes, peduncles and flowers.

Its botanical position is perhaps between *A. binervata* and *A. flavescens*, which latter it approaches in nervation of its phyllodes. From the great size of this tree it was at first thought to be *A. excelsa*, but the nervation, size and shape of phyllodes as well as the inflorescence and pods do not agree with that species.

Analysis Showing Affinities to and Differences from Cognate Species.

A. EXCELSA.

Size: A large forest tree. *Branchlets* terete, glabrous. *Phyllodes* oblong, falcate, obtuse, mucronate, narrowed at the base, 2 to 3 inches long, $\frac{1}{2}$ to $\frac{3}{4}$ inch broad, thinly coriaceous, 5- to 7-nerved or faintly veined between them. *Inflorescence*: Peduncles solitary in pairs or clusters. *Flowers* 20 to 30, petals distinct, smooth; sepals distinct; 5-merous. *Pod* 3 lines broad. *Seed* ovate, longitudinal; funicle short and filiform, neither folded nor enlarged.

A. LAURIFOLIA, Willd.

Size: A tree. *Branchlets* scarcely angular. *Phyllodes* obliquely ovate-oblong, 7-8 nerved, emarginate at the apex, and oblique at the base. *Inflorescence*: Peduncles usually solitary. *Pod* falcate, moniliform.

A. BAKERI.

Size: A large brush tree. *Branchlets* flattened, angular. *Phyllodes* obtuse, broadly lanceolate, narrowed at both ends, 2 to 6 inches long, $\frac{1}{2}$ to 3 inches broad, thinly coriaceous, 2- or 3-nerved, pinnately veined, margins thickened between the veins. *Inflorescence*: Loose, elongated panicles or racemes, peduncles in clusters. *Flowers* few, never more than 20, petals villous, sepals villous, spatulate, 4-merous. *Pod* nearly 6 lines broad, thin, straight. *Seed* ovate, longitudinal, funicle short and filiform, neither folded nor enlarged.

A. BINERVATA.

Size: A tree. *Branchlets* terete. *Phyllodes* as in *A. Bakeri*, but 3 nerves predominate. *Inflorescence*: Axillary racemes.

Flowers about 20, petals smooth, sepals glabrous. *Pod* $\frac{1}{2}$ inch broad. *Seed* obovate, longitudinal, funicle folded and dilated under seed.

A. OVARIA.

Size : A small tree. *Branchlets* angular. *Phyllodes* oblong, falcate, 3-nerved, 2-3 inches long, $\frac{1}{2}$ to 1 inch broad. *Inflorescence* : Racemes short. *Flowers* 30, globose, petals smooth. *Pod* hard, 3 to $5\frac{1}{4}$ inches long, $\frac{1}{2}$ - $\frac{3}{4}$ inch broad. *Seed* elongated, arillus almost encircling the seed in a double fold.

EXPLANATION OF PLATE.

Plate XXI.

ACACIA BAKERI.

- Fig. 1.—Flowering twig.
Fig. 2.—The large form of phyllode, common in this species.
Figs. 3 and 4.—Individual flowers in progressive stages.
Fig. 5.—Pistil.
Fig. 6.—Pod.
Fig. 7.—Seed *in situ*.
Fig. 8.—Seed in longitudinal section.

(Figs. 3, 4 and 5 enlarged.)

NOTES AND EXHIBITS.

Mr. Edgar R. Waite exhibited a number of living "Waltzing" Mice, quite recently received from Japan, where these curious animals appear to have originated. They were first made known in Europe by M. C. Schlumberger, in 1893. Last year he published a description with figures copied from Japanese ivory carvings representing these mice (Mém. Soc. Zool. de France, 1894, p. 63). M. Schlumberger's mice and also Mr. Waite's are white variegated with black; the exhibitor had bred some entirely white but with discernible faint fawn marks indicating what portions would normally be black. These mice are constantly rotating, and this trait constitutes the peculiarity which gives to them their trivial name.

Mr. Maiden showed a series of botanical specimens in illustration of his paper.

Mr. Froggatt exhibited specimens of the beetles described in his paper, and drawings of six of them in different stages of their life-history. Also, some pine resin from the stems of *Frenella robusta*, collected near Wagga, N.S.W., and sent to the Technological Museum, in which are enclosed and beautifully preserved a large number of insects, at least eight different species of *Formicidae*, *Mutilla* sp., *Chalcis* sp., besides about twenty different species of Coleoptera.

Mr. Masters exhibited a very attractive collection of 420 species of Coleoptera collected by him during a stay of five days at Blackheath, Blue Mts.

Mr. Fred. Turner sent for exhibition flowering and fruiting specimens of a plant (*Adriana acerifolia*, Hook.) suspected of poisoning cattle. He also communicated the particulars of two cases in each of which the patient had been authoritatively pronounced by two medical men to be suffering from hydatids, and an operation recommended, but, it was asserted, relief had been otherwise obtained from the use of a decoction prepared from

the leaves and stems of *Goodenia ovata*, Sm., locally called "Native Hops."

Mr. North sent for exhibition the eggs described in his paper.

Mr. Fletcher exhibited specimens of a Land Nemertine obtained by Mr. R. Helms at Pretty Point, Mt. Kosciusko Plateau, probably *Geonemertes australiensis*, Dendy. Also specimens collected by himself near Gosford, of a richer darker red than even the reddest examples of *Geoplana sanguinea*, Moseley, for which when quiescent the animal otherwise might on casual examination fairly pass. The only other record for New South Wales, is of a similar red specimen obtained by Mr. R. Helms in the Richmond River District some years ago.* Professor Spencer had obtained some Tasmanian examples which were longitudinally striped with red; but all the examples from New South Wales yet seen, with the exception of those from Mt. Kosciusko, are still more pigmented.

* P.L.S.N.S.W. 1891. Second Series. Vol. vi., p. 167.

WEDNESDAY, JUNE 26TH, 1895.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, June 26th, 1895.

Professor T. W. E. David, B.A., F.G.S., Vice-President in the Chair.

Mr. J. Jennings and Mr. J. B. R. Garland were introduced as visitors.

DONATIONS.

Pharmaceutical Journal of Australasia. Vol. viii. (1895), No. 5. *From the Editor.*

University of Melbourne—Examination Papers: Final Honour, Degrees, &c., February, 1895; Matriculation, May, 1895. *From the University.*

Société Hollandaise des Sciences à Harlem—Archives Néerlandaises. T. xxix. 1^{er} Liv. (1895). *From the Society.*

Société Royale de Géographie d'Anvers—Bulletin. T. xix. 4^{me} Fasc. (1895). *From the Society.*

Société d'Horticulture du Doubs, Besançon—Bulletin. n.s. No. 52 (April, 1895). *From the Society.*

Department of Agriculture, Brisbane—Botany Bulletin. No. x. (May, 1895); Bulletin. Second Series, No. 5 (April, 1895). *From the Secretary for Agriculture.*

University of Sydney—Calendar for 1895. *From the University.*

College of Science, Imperial University, Japan—Journal. Vol. vii. Part 4 (1895). *From the Director.*

Comité Géologique, St. Pétersbourg—Mémoires. Tome xiv. No. 1 (1895): Bulletin. T. xiii. Nos. 4-7 et Supplément au T. xiii. (1894). *From the Committee.*

Société Belge de Microscopie—Bulletin. T. xxi. Nos. 4-6 (1894-95). *From the Society.*

Royal Microscopical Society—Journal, 1895. Part 2 (April). *From the Society.*

Entomological Society of London—Transactions, 1895. Part 1. *From the Society.*

Journal of Conchology. Vol. viii. No. 1 (January, 1895). *From the Conchological Society of Great Britain and Ireland.*

Department of Mines and Agriculture, Sydney—Annual Report for 1894. *From the Hon. the Minister for Mines and Agriculture.*

Victorian Naturalist. Vol. xii. No. 2 (May, 1895). *From the Field Naturalists' Club of Victoria.*

Royal Society of London—Proceedings. Vol. lvii. Nos. 342-344. *From the Society.*

Geological Society of London—Quarterly Journal. Vol. li. Part 2, No. 202: Geological Literature. June-December, 1894. *From the Society.*

Senckenbergische Naturforschende Gesellschaft in Frankfurt a/ M.—Abhandlungen. xviii. Bd., iii. Heft (1894). *From the Society.*

Naturhistorischer Verein der Preussischen Rheinlande, Westfalens und des Reg. Bez., Osnabrück—Verhandlungen. Jahrg. li. Erstes Hälfte. *From the Society.*

Archiv für Naturgeschichte. 1891, ii. Bd., 3 Heft; 1894, i. Bd. 3 Heft; ii. Bd. 2 Heft. *From the Editor.*

Perak Government Gazette. Vol. viii. (1895), Nos. 10-11.
From the Government Secretary.

Zoologischer Anzeiger. xviii. Jahrg. No. 474 (May, 1895).
From the Editor.

Museum of Comparative Zoology at Harvard College—Bulletin.
Vol. xvi. No. 15 (1895). Vol. xxv. No. 12 (1895) Vol. xxvi.
No. 2 (April, 1895). *From the Curator.*

Asiatic Society of Bengal—Journal. Vol. lxi. Part i., Extra
No. (1892); Vol. lxiii. Part i., No. 4; Part ii., No. 4 (1894): Pro-
ceedings, 1894. Part x. (Dec.); 1895, Nos. i.-iii. (Jan.-Mar.)
From the Society.

Agricultural Gazette of N.S.W. Vol. vi. (1895), Part 5.
From the Hon. the Minister for Mines and Agriculture.

Royal Society of New South Wales—Journal and Proceedings.
Vol. xxviii. (1894). *From the Society.*

Australasian Journal of Pharmacy. Vol. x. No. 114 (June,
1895). *From the Editor.*

State Board of Fish Commissioners, Michigan—Eleventh
Biennial Report (1895). *From the Commission.*

Royal Society of Queensland—Proceedings. Vol. xi. Part 1
(1895). *From the Society.*

Pamphlet entitled "Australian Hepialidæ." By A. Sidney
Olliff. *From the Author.*

Zoological Society of London—Abstract, 7th May, 1895. *From
the Society.*

Naturwissenschaftlicher Verein zu Bremen—Abhandlungen.
xiii. Bd., 2 Heft (1895); xv. Bd., 1 Heft (1895). *From the Society.*

Société Linnéenne de Normandie—Bulletin. 4^e Série. Vol.
viii (1895). *From the Society.*

American Naturalist. Vol. xxix. No. 341 (May, 1895). *From
the Editors.*

American Museum of Natural History—Bulletin. Vol. vii. Sig. 5-9, pp. 65-144 (1895). *From the Museum.*

Société Royale Linnéenne de Bruxelles—Bulletin. xx^{me} Année, No. 7 (May, 1895). *From the Society.*

Australian Museum—Report of Trustees for the year 1894. *From the Museum.*

Pamphlet entitled “On the Significance of the Proliferated Epithelium in the Fœtal Mammalian Jaw.” By R. Broom, M.B., B.Sc. *From the Author.*

DESCRIPTIONS OF SOME NEW ARANEIDÆ OF NEW
SOUTH WALES. No. 5.

BY W. J. RAINBOW.

(Plates XXII.-XXIII.)

Family EPEIRIDÆ.

Genus NEPHILA, Leach.

NEPHILA FLETCHERI, sp. nov.

(Plate XXII. figs. 1, 1a.)

♀. Cephalothorax, 8 mm. long, 5 mm. broad; abdomen, 12 mm. long, 6 mm. broad.

Cephalothorax dark mahogany-brown, thickly clothed with hoary hairs; *caput* elevated, rounded on sides and upper part, deeply compressed at junction of cephalic and thoracic segments, forming deep, sublateral indentations; these latter only thinly furnished with short, hoary hairs; at posterior extremity of cephalic segment there are two coniform tubercles of dark mahogany colour. *Clypeus* broad, moderately convex, clothed with hoary pubescence, indented laterally; a deep, broad, transverse groove at centre; indentations and grooves sparingly pubescent. *Marginal band* narrow, fringed with hoary hairs.

Eyes of an opaline tint, placed on dark rings; the four central eyes are seated on a moderately convex eminence, and form an almost quadrangular figure; of these the front pair are somewhat the smallest, and are separated from each other by about twice their individual diameter; the posterior pair are also divided by a distance equal to twice their individual diameter; the lateral pairs are much the smallest, and are placed obliquely on small tubercles, but are not contiguous.

Legs long, slender, yellow-brown; *trochanters* sparingly pubescent, few short spines; *femora* thickly clothed with long yellow hairs, and armed with rather short spines; *tibial joints* armed with short spines and bristles; *metatarsi* and *tarsi* dark brown, thickly clothed with short dark brown bristles; *superior tarsal claws* moderately long, curved and pectinated; *inferior claw* sharply curved. Relative lengths of legs 1, 2, 4, 3; of these the third pair are much the shortest.

Falces dark brown, approaching bistre, somewhat conical, divergent at apex; the margins of the furrows of each falx are armed with a row of five teeth.

Maxillæ yellow-brown, outer margins bistre, rather longer than broad, divergent; few coarse dark hairs.

Labium yellow-brown, longer than broad, about half the length of maxillæ; furnished with a few short dark hairs.

Sternum yellow-brown, shield-shaped, outline sinuous; surface uneven, sparingly clothed with white pubescence.

Abdomen ovate, moderately convex, projecting over base of cephalothorax; superior surface sparingly pubescent, yellow-brown, somewhat darker towards posterior extremity; ornamented with 17 spots, and, from near centre to posterior extremity, five indistinct parallel, though somewhat uneven, lines; of the former there are six conspicuous spots and 11 minute ones; the larger ones are distributed in three pairs, the first of which is seated well forward; between the individuals comprising the first pair there is a minute spot; below the first pair there are six minute spots, arranged in two rows, the first of which contains four individuals, and is slightly curved; the second pair are placed near the centre, and each spot of the first and second pairs are relieved by an almost circular yellow patch or disc, rather more than its own diameter; the third pair are seated lower down, but are not nearly so dark as those of the first and second pairs, nor are they relieved in like manner; towards the posterior extremity there are two smaller and less distinct pairs; the parallel lines or markings commence at a point above second pair of spots, and run midway between

them; at their commencement the design represents a bifurcated figure, the two outer lines forming a junction just between the spots referred to, from whence they suddenly open out; the centre line commences below junction of outer lines, and terminates at a point rather lower down at posterior extremity than its neighbours, the two other lines start at a point about midway between second and third pairs of spots, from whence they open out, and intersect the outer and centre lines; in addition to the lines described, there are also faint oblique and transverse uneven markings both above and below third pair of distinct spots; sides yellowish, mottled with brown, dark brown patches in places; ventral surface dark brown, interspersed with yellow; a broad transverse yellow band, uneven in outline, extends immediately below branchial opercula, the band is curved posteriorly; above the region of spinnerets there is a second, transverse, yellow band, but this is much narrower and more even in outline than the former; this band is much more curved than the former, the curvature being directed forward; there are also two yellow patches closely contiguous to base of spinners.

Hab.—New England District, N.S.W.

I have very much pleasure in associating this specimen with the name of my esteemed contemporary, J. J. Fletcher, Esq., M.A., B.Sc., to whom I am indebted, not only for the one herein described, but also for other interesting specimens, as well as much valuable assistance in other directions.

NEPHILA EDWARDSII, sp.nov.

(Plate XXII. figs. 2, 2a.)

♀. Cephalothorax, 8 mm. long, 5 mm. broad; abdomen, 14 mm. long, 7 mm. broad.

Cephalothorax and *eyes* similar to *N. Fletcheri*.

Legs long, slender, brown with yellow annulations at joints; *trochanters* moderately hairy, few short spines; *femora* thickly clothed with rather long dark hairs and spines; *tibial joints*, yellow annulations at commencement, below dark brown, approaching sepia, thickly furnished with long dark hairs or bristles and

spines; *metatarsi* and *tarsi* dark brown approaching sepia, thickly clothed with dark bristles; *superior tarsal claws* moderately long, curved and pectinated; *inferior claw* sharply curved. Relative lengths 1, 2, 4, 3; of these the first pair are the longest, the second and fourth pairs coequal; third pair much the shortest.

Palpi moderately long, similar in colour and armature; terminal claw slightly curved, and armed with four teeth near the base on the underside.

Falces dark brown, vertical, somewhat conical, divergent at apex; the margins of the furrows of each falx armed with a row of five teeth.

Maxillæ dark brown, approaching bistre, rather longer than broad, divergent, fringed with rather long black hairs.

Labium dark brown, longer than broad, about the length of maxillæ.

Sternum shield-shaped, sparingly hairy, tubercular, yellow-brown; dark brown patch at centre.

Abdomen ovate; moderately convex, projecting over base of cephalothorax; superior surface pubescent, light brown, ornamented by a large number of symmetrically disposed punctures, six of the largest of which are situated tolerably well forward, forming a somewhat triangular figure; immediately above these there are 12 smaller punctures forming an arch, and immediately underneath seven minute ones arranged in the following order:—1, 2, 1, 2, 1; in addition to these there are 11 other punctures as large as those comprising the triangular figure, disposed in three rows, each slightly curved, the curvature being directed forward; of these the first row, which is situated near the centre, contains three, and the second and third four each; besides the punctures herein described the posterior portion of the abdomen is further ornamented by four tolerably distinct longitudinal parallel lines or markings; each lateral line commences at the centre of the lateral punctures of the first row of three, and running to the tip of the abdomen intersects each lateral puncture of the second and third rows; the inner lines commence as a single one at a point

above the centre puncture of the first row, intersecting it, and continue as such until near the two inner punctures of the second row, where it opens out and forms two lines; from thence they proceed to the extremity of the abdomen, intersecting each puncture; laterally the colour, towards the dorsal surface, is a shade darker, but lower down a rich nut-brown colour prevails; the sides are ornamented with yellowish wavy markings; ventral surface dark brown, with yellowish lateral and transverse markings. *Epigyne* a transverse, oval, dark brown eminence, concave within.

Hab.—Sydney.

The specimen described above was obtained by Dr. C. A. Edwards, M.D., M.R.C.S., Edin., of Waverley, and it affords me great pleasure in connecting his name with it. To the same gentleman I am indebted for many other interesting specimens and much valuable information as the result of personal and independent observation.

NEPHILA VENTRICOSA, ♂. *et* ♀., sp.nov.

(Plate XXIII. figs. 1, 1a, 2, 2a.)

♂. Cephalothorax, 2 mm. long, 1.5 mm. broad; abdomen, 2 mm. long, 1.5 mm. broad.

Cephalothorax convex. *Caput* yellow, furnished with few short yellowish hairs, normal grooves and indentations indistinct. *Clypeus* dark brown.

Eyes prominent, glossy black, the four centrals form a somewhat quadrangular figure; lateral pairs much the smallest, placed obliquely on minute tubercles; not contiguous.

Legs long, slender, tapering to a point, yellowish, furnished with rather long hairs and spines; *superior tarsal claws* long, curved and pectinated; *inferior claw* sharply curved. Relative lengths 1, 2, 4, 3; the second and fourth pairs are coequal, or nearly so, while the third pair is by far the shortest.

Palpi: humeral joint slender, yellow, few black hairs and slender bristles; nearly twice as long as cubital and radial joints

together; of these two latter, the radial is rather the longer, and each is similar in colour to humeral joint; two large bristles project from radial joint, the shorter directed outwards, and curving slightly backward, the longer and stronger one curved and directed forward; digital joint twice as long as the three former, dark brown, hairy; palpal organs simple, bulb large, hairy on upper-side, glossy underneath, terminated by a long flagellum; bulb hairy, concave on inner side; curving over bulb from basal end is a long, stout, dark process.

Falces yellowish, long, vertical, divergent at apex.

Maxillæ yellowish, outer margins dark, longer than broad, divergent, few coarse dark hairs.

Labium yellow, longer than broad, rather more than half the length of maxillæ.

Sternum yellow, shield-shaped, furnished with few rather long coarse hairs.

Abdomen ovate, moderately convex, hairy, projecting over base of cephalothorax, dark brown, mottled with yellow.

Hab.—Sydney.

♀. Cephalothorax, 9 mm. long, 7 mm. broad; abdomen, 22 mm. long, 13 mm. broad.

Cephalothorax black, clothed with hoary hairs. *Caput* elevated, rounded on sides and upper part, truncated in front, sides furnished with hoary hairs, apex glossy black; at junction of cephalic and thoracic segments there are two coniform tubercles. *Clypeus* broad, moderately convex, thickly clothed with hoary hairs; there are central and lateral depressions, the former sensibly the deepest; depressions black and devoid of hairs. *Marginal band* rather broad, clothed and fringed with hoary hairs.

Eyes with pearl-grey lustre; distributed as in *N. Fletcheri* and *N. Edwardsii*.

Legs long, yellow, annulated with dark brown, furnished with rather long hairs and short spines; the former are longest at the sections where the annulations occur; the *tibial joints*, *metatarsi*,

and *tarsi* dark brown, approaching sepia; *tarsal claws* as in *N. Fletcheri* and *N. Edwardsii*. Relative lengths 1, 2, 4, 3.

Palpi moderately long; humeral and cubital joints yellowish, the others dark brown, approaching sepia; similar in armature to legs.

Falces black, glossy, vertical, divergent at apex; armed with a row of five teeth along each margin of the furrow of the falx wherein the fang lies concealed when at rest.

Maxillæ sepia, inner margins yellowish, longer than broad, divergent; a few coarse dark hairs on outer margins.

Labium dark, glossy, yellowish patch in centre, about half the length of maxillæ; furnished with few rather long dark hairs.

Sternum orange-yellow, dark irregular transverse band at middle, shield-shaped, tuberculate.

Abdomen ovate, exceedingly convex, projecting over base of cephalothorax, pale yellow, somewhat darker at posterior extremity, clothed with minute hairs; dorsal surface ornamented with a curved row of 10 minute dark spots towards anterior extremity; seated lower down are two other dark spots, much larger than those of the curved series, and each is relieved by a circular pale yellow patch or disc at the upper margin, in a somewhat lateral position; from the lower lateral margin of each spot there extends in an outward oblique direction a short slightly curved line, terminating with a minute spot; immediately between the curved lines there is a short straight longitudinal line; at the centre of dorsal surface there are other two dark spots, more widely removed than former pair, and each is also relieved by a circular pale yellow patch or disc; midway between these two latter spots, and connecting them, is a series of longitudinal parallel and curved markings, which proceed therefrom and terminate at posterior extremity (*vide* fig. 2, Pl. XXIII.); near posterior extremity, and inside lateral longitudinal lines, there are two small yellow discs separated from each other by two parallel lines; laterally the abdomen is much darker, and is ornamented with four broad white irregular bands; ventral surface dark brown,

ornamented about midway between branchial opercula and spinnerets with a yellowish transverse, slightly curved band, the lateral extremities of which are somewhat abruptly directed towards posterior extremity. *Epigyne* a dark brown, glossy, transverse oval eminence, concave within.

Hab.—Sydney.

The spiders of the genus *Nephila* are undoubtedly one of the most interesting groups of Australian orb-weavers, both as regards their size, beauty and webs. Representatives of the genus abound in tropical and sub-tropical regions, often occurring in communities, and constructing their webs closely together, occasionally within reach, but not infrequently from 10 to 20 feet from the ground, and always in a position exposed to the rays of the sun. The snares are bright yellow, and so remarkably viscid as to follow the point of a needle; they vary in diameter from three feet upwards, while the supporting lines or guys sometimes measure from 10 to 12 feet.*

So strong are these snares that small birds are occasionally entrapped by them. The writer on one occasion saw a young bird that had been newly caught in the web of a *Nephila* in the vicinity of Sydney. It was in vain the unhappy bird struggled to free itself from the toils; the more it fought, the more hopeless became its position, while the damage inflicted upon the web was considerable. And the spider itself was evidently afraid of the victim. It had taken its position in the usual spot—the centre—its huge legs spread out, covering a space of four or five inches. Occasionally it ran from the centre towards the struggling bird, but speedily retraced its steps. All this time the spider was throwing threads around the body of the victim, and rapidly enveloping its head and wings. As a result the struggles became less desperate, until at length they ceased, death resulting apparently from exhaustion. Bushmen have assured the writer

* According to Gräffe, a large species of *Epeira* occurs in the Fiji Islands, which constructs a strong web often 30 feet or more in diameter. Verh. Zool. Bot. Ges. in Wien, xvi. p. 500. [Doubtless one of the *Nephile*.—W.J.R.]

that, riding through the bush in the autumn, they have seen skeletons of small birds hanging in the webs of "triantelopes," as they are pleased to call them. Mr. J. A. Thorpe, of the Australian Museum, Sydney, has informed the author that at Madden's, near Belle Plains, he has met with specimens of the emu wren (*Stipiturus malachurus*) entangled in the sticky meshes of the webs of spiders of the genus *Nephila*; also at Cape York, he had seen several of the blue-warblers, notably *Malurus amabilis*, Gould, and *M. Brownii*, Vig. et Horsfield, that had fallen victims in a like manner. It must be noted, however, that it is only young birds or those of a weak wing-power that are so captured. An Indian writer states that in many unfrequented dark nooks of the jungle the traveller comes across most perfect skeletons of small birds caught in the powerful snares of the *Nephilæ*, the strong folds of which prevent the delicate bones from falling to the ground after the wind and weather, together with other agencies, have dispersed the flesh and feathers. Further, a naturalist, writing under the *nom-de-plume* "H. A. H.," from Cashar, to the *Asian*, stated that he had "received from a neighbouring planter an adult female of the three-toed Kingfisher which was found entangled in a spider's web. Although true Kingfishers, these lovely birds feed largely on insects. Curiously enough," continued the writer, "the stomach of the last bird I preserved contained a large brown spider. Doubtless the bird went either for the spider or some insect caught in the web, and got entangled in the sticky meshes."

Some writers on this subject have supposed, and even boldly asserted, that birds so caught were devoured by the spiders in whose webs they had become entrapped, but this conclusion is in my opinion erroneous. In 1834 the late W. S. Macleay, F.Z.S., in a paper* communicated to the Zoological Society, London, wrote:—"Now, it is certainly possible that the net of *Nephila* should, in accord with Labat's account, accidentally arrest such small birds as are several species of *Trochilide*; but I do not

* Trans. Zool. Soc. 1834, pp. 192-3.



believe that a spider would touch them. My garden, I repeat, is full of these *Nephilæ* in autumn, and I tried to regale one of them with a small species of *Sphærio dactylus* by putting it into her net. The spider on feeling the threads vibrate with the struggles of the lizard instantly approached and enveloped it in her web. As soon, however, as it was thus disabled, my *Nephila* seemed to become aware of her mistake, and losing no time in cutting the lines, allowed her prisoner to fall to the ground." This conclusion, however, Mr. Macleay felt called upon six years later to withdraw, for in a letter to W. E. Shuckard, Esq.,* dated Sydney, 7th April, 1840, he stated that:—"In the vicinity of Sydney he had met with a true bird-catching spider, he having himself found one of the *Epeiridæ* actually devouring one of the young of the *Zosterops* that had recently flown from the nest; and which is not a solitary instance, as his father, A. Macleay, Esq., had previously observed a similar fact."

It is abundantly clear from the foregoing that the snares of certain spiders arrest the young of certain birds, as also those of a weak wing-power, but the author is decidedly of opinion that the spiders in question do not obtain or receive nourishment from their ornithological victims. The webs are not set with the object of catching any such game. Each snare is placed in its position by the unerring instinct of the spider, simply because the situation is such as will assure abundance of food in the shape of insects, and it is merely an accident when a bird becomes ensnared in the toils.

I do not deny that a *Nephila* has been observed with its fangs plunged in the body of an ensnared bird, but that is not evidence *ipso facto* that it was making a meal. It is more than likely, indeed, that it attacks the bird, when it can safely do so, for the purpose of injecting its poison, thus hastening death, and preventing the victim from too seriously injuring its web. Moreover, it must be noted that when any insect becomes entangled in the web of a *Nephila* the spider rushes upon the intruder, and plunging

* Lardner's "Cabinet Cyclopædia," p. 382.

her fangs therein, maintains her grasp until death ensues; thereupon she envelopes the body in her thread and bears it to a quiet spot, where she can devour in peace her spoil. This scene could hardly be enacted by the largest *Nephila* on the smallest bird known. Such, however, is my belief, and I feel certain that any who will observe for themselves, and closely watch the subject, will ultimately bear out my view of the case. It is, unhappily, too often a fact that observers are in many instances prone to hasty conclusions, and in recording these, render unsatisfactory, or even useless, observations that might otherwise be of immense value as data.

The webs of these spiders are composed of two kinds of silk; one yellow, exceedingly viscid, and elastic; the other white, dry, and somewhat brittle. The latter is used in the construction of the framework, guys, and radii, and the former the concentric rings or spirals. The spirals are exceedingly numerous, and as a rule somewhat less than one-third of an inch distant from each other. Between every eight or ten of these circles there is a white thread, which, however, does not form a complete circle, but is looped up and returned in an opposite direction to a corresponding point on the other side of the web. These white lines are put in before the yellow ones are constructed, and doubtless serve to strengthen the huge mesh.

As the result of experiments with the American species, *Nephila plumipes*, Professor Wilder proved* that these spiders have the power of regulating the thickness of the thread voided, and also that they can produce either yellow or white silk at will, and he even succeeded in drawing off both by artificial means. The Professor wound off silk from the species mentioned for an hour and a quarter, at the rate of six feet per minute, making a total of 450 feet, or 150 yards. This he afterwards removed from the quill for the purpose of ascertaining its weight, and it was found to be one-third of a grain. It was ascertained that it was impossible to reel off more than 300 yards of silk from a spider at one

* Proc. Bost. Nat. Hist. Vol. x. p. 200.

time; but this evidently did not exhaust the supply, for on opening the abdomen the glands were found to be still partially filled. Further experiments led this enthusiastic naturalist to believe that *N. plumipes* could be bred in large numbers and utilised for its silk, and for this purpose he suggested that each spider be kept by herself in a wire ring surrounded by water, fed with flies bred for the purpose from old meat, and milked each day of her silk. Every day or two each spider should be taken down, put into a pair of stocks, and milked of its thread until it no longer yielded. By adopting this plan an ounce of silk might be obtained from each spider during the summer. The silk thus reeled off is much smoother and more brightly coloured, as well as finer than that of the silkworm. Several threads would have to be twisted together to obtain one of workable thickness. Although the yellow silk when present in the web is so remarkably viscid and flexible, the same material when drawn off artificially is quite dry and far less elastic.

Now, while it is possible to breed spiders of this or any other genus, and to obtain silk in the manner suggested, the difficulties in the way are far too great for any serious effort in the direction indicated by Wilder, as the space needed for keeping each spider by herself, and the amount of labour necessary to provide them with living food, and to draw off the silk, would render the product too expensive for use.

Spiders of the genus *Nephila*, when in captivity, become quite tame, and soon learn to distinguish their attendant. I have kept numbers of them, and have noticed that, although at first very shy, they quickly learned to take food from the hand, and also water when offered to them on a small camel-hair brush. Exceedingly voracious naturally, they can nevertheless exist for many days without either food or water.

The males of this genus are veritable pigmies in comparison with the females, though in proportion to their size, the legs of the latter are considerably longer; the markings of the male, while similar in many cases to that of the female, are not as distinct, but run together and appear darker.

In autumn these spiders pair. The sexes usually inhabit the same web for a considerable time, the female occupying her customary position in the centre, and the male taking up quarters on the upper edge of the web. Before running down to the female he tries the tension of the web with his feet, after which he proceeds nimbly and lightly, so as not to attract her attention or disturb her in any way, climbs upon her back, and contents himself for a while in moving about in a seemingly objectless manner. During these proceedings she is not all resentful, but apparently disdains all notice. Emboldened by her apparent indifference he endeavours to climb down to the underside of her abdomen, whereupon she immediately shows fight. In an encounter with an adversary of such prodigious proportions in comparison with himself, it is obvious he would be no match; he therefore scrambles off as quickly as possible, and dropping out of the web, remains suspended in the air, or resting upon an adjacent leaf or branch for some time, after which he renews the attack. It not infrequently happens that he has to repeat his efforts several times, and from these he rarely retires scathless, often losing two or three legs. Ultimately, however, he succeeds in attaching himself in the requisite position, and performing the necessary act of fecundation.

Towards the end of April or the beginning of May, the cocoons are constructed. In *Nephila Edwardsii*, the ovisac is about $\frac{5}{16}$ in. in length, oval, bright golden yellow, and surrounded by an immense quantity of loose silk of a like colour. The cocoons contain from 500 to 1000 eggs. After hatching the spiderlings live together for two or three weeks, spin a web in common, and eat one another or any small insects that may come their way. After this the survivors separate, and each constructs a web on her own account.

The following is a list of the described *Nephilæ* of Australia previous to the publication of the present paper. Those species marked with an asterisk have been described and figured by Koch in Band I. of his admirable work, "Die Arachniden Australiens." Localities outside Australia are in italics :—

- N. venosa*,* pp. 148-9, T. xii. figs. 1, 1a; Brisbane, Port Mackay, and *Ovalau*.
N. victorialis,* pp. 150-1, T. xii. figs. 3, 3a, 3b; Rockhampton.
N. nigratarsis,* pp. 152-3, T. xii. figs. 4, 4a, 4b; Rockhampton and Port Mackay.
N. flagellans,* pp. 153-6, T. xii. ♂. figs. 5, 5a, 5b; ♀. figs. 6, 6a; Sydney.
N. fuscipes,* pp. 156-7, T. xiii. figs. 1, 1a; Port Mackay, Rockhampton, Bowen, and *Pelewinsehn*.
N. imperatrix,* pp. 159-60, T. xii. 3, 3a, 3b, 3c; Rockhampton.
N. aurosa,* pp. 160-2, T. xiii. fig. 4; Port Mackay.
N. procera,* pp. 162-3, T. xiv. fig. 1; Port Mackay.
N. sulphurosa,* pp. 163-5, T. xiv. fig. 2; Port Mackay.
N. tenuipes,* pp. 165-6, T. xiii. figs. 5, 5a; Port Mackay.
N. Cunninghamii (W. S. Macleay), King's "Survey of Australia," Vol. II. pp. 468-9. [Locality not given.]

NOTE.—In Vol. VIII. (Series 2nd), P.L.S.N.S.W., pp. 292-3, Pl. x. figs. 4, 4a, 4b, 4c, 4d, 4e, 4f, under the title of "Descriptions of Some New Araneidæ of New South Wales (No. 3)," I described and figured a new species of *Stephanopsis*, for which I proposed the name *hirsuta*. Since the publication of the paper referred to, I find I have inadvertently used a preoccupied name. I now propose that the species described shall be known as *S. hispida*.

EXPLANATION OF PLATES.

PLATE XXII.

- Fig. 1. —*Nephila Fletcheri*.
 Fig. 1a.— „ „ profile of abdomen.
 Fig. 2. — „ *Edwardsii*.
 Fig. 2a.— „ „ profile of abdomen.

PLATE XXIII.

- Fig. 1. —*Nephila ventricosa* ♂.
 Fig. 1a.— „ „ maxillary palpus ♂.
 Fig. 2. — „ „ ♀.
 Fig. 2a.— „ „ profile of abdomen.

NOTES ON THE METHODS OF FERTILISATION OF THE *GOODENIACEÆ*.

PART II.

BY ALEX. G. HAMILTON.

(Plate xxiv.)

The interesting genus *Dampiera* is entirely Australian, and is remarkably distinct and easily determined.

The calyx-tube is adnate to the ovulary, which is in nearly every case 1-celled. The corolla-tube is deeply slit; the two upper lobes stand well above the lower three, and are closely pressed together, the posterior margins folding in between the lobes, and forming a cavity or auricle which encloses the style and indusium, and which is of various degrees of complexity in different species. The auricle may be taken as characteristic of the genus, for although it is found in *Goodenia*, *Velleja*, and *Anthotium*, yet in its highest development in those genera, it does not approach the simplest form in *Dampiera* as regards completeness of structure. The anterior margins of the upper lobe also fold under into the tube of the corolla, projecting in such a manner as to cause the auricles to separate when an insect forces its way into the tube. The three lower lobes are spreading and usually broadly winged; at their base the wings are narrower and puckered up by the close approach of the lobes, forming guiding lines to the nectar. The throat is always glabrous and free from hairs. The anthers are connate round the style, although in very young buds they are sometimes free, but the growth of the anthers locks them together later on. The style is always glabrous, and often deeply coloured; the indusium is never hairy on the outside as in every other genus except *Brunonia* (and even in this there are hairs in the early

stages, which are deciduous), and rarely ciliate on the lip. The lip of the indusium is shallow, and usually divided into two, or sometimes four, by notches. The indusium and stigma are in most species of a very dark colour. The stigma rarely grows out to project beyond the indusium lips, which is also the case in other plants of the order. The plants, with the exception of *D. diversifolia*, De Vr., are always clothed with silky, cottony, woolly, stellate or branching hairs on the calyx, and the outside of the corolla (except the wings) and sometimes on the stems and leaves. The flowers are almost always blue or purple. In the remarks on the genus in *Flora Australiensis* [1] the colour is said to be blue, purple, red, white, or rarely yellow. This latter colour I have not seen in any fresh specimens (except in the tube), and in dried plants it is very difficult to make out the colour. But from an analysis of the descriptions in *Flora Australiensis*, it appears that of the 34 species described, 23 are blue or purple, 1 white, and 1 (*D. rosmarinifolia*, Schl.) is said to be white, blue or red; while 9 have no colour mentioned.

The characteristic features by which they may be recognised are the solitary ovules, connate anthers, the auricles, and the hairless style and indusium.

From their dense covering of hairs they have the aspect of desert plants, and judging by the number of species collected by the Elder Expedition, they are plentiful in the arid interior of Australia as compared with other genera of the order. And many of the species of other genera occurring there are also tomentose. The Census of Australian Plants [2] gives in all 38 species of the genus, which are distributed as follows:—West Australia has 29 species, 26 of which are endemic; South Australia 5 species, none endemic (this number would probably be much higher were the central parts of the colony collected over); Victoria has 5 species, none endemic; Tasmania has 1 species found elsewhere also; New South Wales has 7 species, 1 being confined to the colony; Queensland has 6 species, 2 endemic; and North Australia 1 species, occurring elsewhere also. From this it will be seen that the head-quarters of the genus is in West

Australia, and a close examination of all the species there would doubtless reveal some interesting indications of the line of evolution. One or two such facts came under my notice in working out some species from that colony.

I have to thank Mr. C. Moore, F.L.S., Director of the Botanical Gardens, and Mr. C. T. Musson, F.L.S., for specimens of several New South Wales *Dampieras* and other Goodeniads, and through the kindness of Mr. J. H. Maiden, F.L.S., Director of Technical Education, and Mr. J. J. Fletcher, I have been enabled to see and analyse the species of *Dampiera* collected by the Elder Expedition, and presented to the herbaria of the Technological Museum and the Linnean Society. It is these and some fresh New South Wales species that I propose to treat of in the following notes.

1. DAMPIERA BROWNII, F.v.M.

In the young buds the stigma is button-shaped, no indusium being visible, but a slight fosse shows across the top (Fig. 1). In the next stage the indusium shows as a thin wall of irregular height all round, but with a notch at each end, and at right angles to the line of the stigmatic groove. During these stages the whole pistil is green. At the next stage the indusium is grown up level all round (Fig. 2), except at the notches, and both indusium and stigma are coloured deep purple, but the style remains green; the purple colour appears first on the stigma, and spreads afterwards to the indusium. The style still continues to elongate and passes into the auricle, the top of the style bending over so as to bring the opening over the junction of the two auricles. During this period the indusium closes by the opposite segments (divided by the notches) approaching, and at last there is only a small circular opening. The indusium has been packed with pollen by growing up through the anthers while the mouth was wide open, and when the stigma begins its outgrowth at this period it forces the pollen out in a small worm-like string, which when exposed to the air falls in powder into the auricles, where it lies. An insect forcing its way into the tube of the flower presses

against the fold of the anterior margin and so moves the auricles apart, when the pollen falls in a small shower on its thorax and head. All these contrivances point towards insect-fertilisation, but to complete the process one would imagine that the stigma should now grow beyond the lips of the indusium and project as has been described in *Scavola* and *Selliera* [5]. But in at least ninety-five per cent. of the flowers the stigma does not project at all beyond the mouth, and in many it does not grow up to the level. Examination of large numbers of flowers just withering showed the outside of the indusium, the stigma, and between the stigma and the inner side of the walls of the indusium coated evenly with pollen all over, and this was apparently caused by the close fit of the auricles round the style applying the pollen, and not by insect agency at all. I can only conjecture that the plant is ordinarily self-fertilised, although occasionally cross-fertilisation may occur from insect visits when the stigma is outgrown or near the mouth of the indusium. From the firmness of the hold which the auricles have upon the style, any insect would, in forcing its way in, press hard against the style and might thus deposit pollen upon the stigma, even though it was only at the mouth of the indusium, instead of projecting as in other genera. It is usual to find the auricles full of pollen where the flower and even the style is withered, so that insects do not commonly exhaust the pollen. The flowers are very sweetly scented, and there is a considerable amount of moisture at the base of the petals, in which, however, I could not detect any sweetness. As already pointed out, the membranous edges of the three lower petals are closely pressed together in the tube, and pucker so as to form guiding ridges (Fig. 3). The flowers are much frequented by Thrips. The auricles in the early bud are green, without any deep concavity, and with a pale red spot where the deepest colour occurs in the mature flower; this is indicated by the dotted oval in Fig. 4, which represents a young auricle. In this stage it resembles the mature auricle in *D. linearis* (Fig. 12). It gradually darkens till it is a fine purple-red with the central part a purple-black of wonderful intensity. This bears out Dr. A. R. Wallace's

theory that the parts of an organism that have undergone the most modification also show the greatest depth of colouring. The flower-stalks and undersides of the leaves are densely covered with stellate hairs; the upper-sides of the leaves are less thickly covered, and the edges are armed with short thick conical hairs. The calyx and lobes of corolla (but not the membranous wings) are covered with dark olive-green branching hairs, resembling those of *D. luteiflora* (Fig. 14).

Referring to this genus, Mr. Bentham says [3]: "In *Dampiera* the summit of the style, when short in the buds, has the appearance of an ordinary peltate stigma, except that it is not yet papillose, flat and nearly circular, with the rudiment of the stigma across the centre. It soon rises, the margins are raised into a short almost two-lipped indusium; but I do not find that it carries any pollen with it, and the stigma does not assume the perfect appearance till the whole indusium and the stigma has ensconced itself between the two upper petals, which closely embrace it by means of two thickened concave appendages, requiring some external agency to open them and give access to the pollen."

This is a perfectly accurate description of the mechanism of the flower, except that the pollen is carried by the up-growing style. Indeed, in reading the paper I was struck with the correctness of the descriptions of the process in all the genera; and it is all the more remarkable when it is remembered that the author had only dried plants to deal with.

After finishing the above account of *D. Brownii*, I observed a fact which I had previously missed, but which is of great importance. A very large proportion of the flowers of this species are resupinate, so that the auricles are on the lower side and the three other petals on the upper side of the flower. When a flower is in this position it is manifestly impossible for the pollen accumulated in the auricles to drop out on the insect. But on the other hand, an insect visiting such a flower would be smeared on the underside by the projecting stream of pollen coming out of the indusium, and in visiting another flower in which all the pollen had been exuded the pollen from other flowers would be left on

the indusium and would so have a chance of reaching the stigma, even if that organ did not grow out. It is remarkable, however, that in the same plant some flowers should be resupinate and others in the ordinary position. So far as I know of the other genera only *Leschenaultia* has resupinate flowers.

2. DAMPIERA STRICTA, R.Br.

This species on the whole resembles *D. Brownii* in its mechanism, but with some minor differences. It grows in patches in swampy ground, and flowers very freely, so that the masses are very conspicuous. The colour is bright blue with a yellow eye. The indusium has four notches (Fig. 6), and closes more completely than in the last species (Fig. 7); the edges are not even, but slightly ragged, and the shoulder of the indusium is papillose, as shown in the figure. The auricles resemble those of *D. Brownii*, but have a fringe of sticky crimson hairs along the posterior margin (Fig. 8) which are generally longer on the left-hand lobe (looking from behind the flower). In this it resembles *D. eriocephala*. Guiding ridges are present in the tube of the corolla, which is yellowish. The stem, calyx and centre of the outside of the corolla-lobes are hairy, the hairs being either stellate or branching. In the latter case they are very curious in form (Fig. 9). I am at a loss to imagine what can be the function of the trichomes on the edge of the margin, unless they are to exclude small creeping insects, or to prevent moisture from gaining access to the pollen, as mentioned later on. They certainly do not keep Thrips out. The stigma rarely grows out level with the mouth of the cup; the auricles are usually full of powdery pollen, and the style and indusium evenly coated with it. The flowers spread out in a horizontal plane. The process of fertilisation is as in the last species so far as I can see—that is to say, usually self-fertilisation obtains.

3. DAMPIERA LINEARIS, R.Br.

Of this species I have examined only dried specimens. The calyx and corolla are covered with hairs resembling those of *D.*

luteiflora. The indusium is not two-lipped but continuous all round, and shows an approach to ciliation (Fig. 11). The stigma, in perfect flowers, is very near the mouth as shown in the figure. As I had flowers only to examine, I do not know how it is placed in the bud. The auricle (Fig. 12) shows little differentiation, the wing which forms it being merely folded inwards, and slightly hollowed for the reception of the indusium. It is not coloured. In the imperfect ciliation, it forms a link between *Scavola* and *Goodenia* on the one hand, and the more complicated arrangements of the typical *Dampieras* on the other. The margin indeed resembles that of *Scavola ovalifolia* in early bud, where the cilia at first exist as a thin membrane continuous all round the indusium, which afterwards breaks up into separate cilia. The plant is obviously well adapted for insect-fertilisation, as a pollen-coated insect, pressing into the tube, could scarcely fail to leave pollen on the stigma.

4. DAMPIERA sp?

An unnamed species from Yeodamie, W.A., in the Technological Museum Herbarium, has the auricle more developed (Fig. 13) and coloured, but not deeply; the indusium also is pale in tint, and, as in *D. linearis*, there is an approach to ciliation of the margin of the indusium. This species is closely covered with cottony hairs. Like the last, it is probably insect-fertilised.

5. DAMPIERA LUTEIFLORA, F.v.M.

I have seen only dried specimens. The calyx, corolla and stems are thickly covered with yellow hairs, mostly branching (Fig. 14). The indusium is very short and two-lipped (Fig. 16). I did not see an outgrown stigma, or even one level with the mouth, but the amount of material at my disposal was so small that it cannot be said certainly that it does not do so. But from the shallowness of the indusium, this would be a matter of less importance, and would not, as in some other species, be any impediment to the deposit of pollen on the stigma by insect agency. The shoulder of the indusium is papillose as in *D. stricta*. The auricle (Fig. 15) is rather simple. The indusium is invariably full of pollen, and it is present also in the auricles.

6. DAMPIERA LINSCHOTENII, F.v.M.

Dried specimens only were examined. The plant is hairy on the calyx and corolla, the hairs being branched. The indusium is markedly two-lipped (Fig. 20), deep, and full of pollen. The stigma in the one flower I had for examination was not outgrown. The indusium is deeply coloured, and the colour runs down the style a short distance. The auricles (Fig. 21) are deeply coloured, and are considerably differentiated. This species, therefore, falls in the group like *D. Brownii*, the members of which are not perfectly adapted to insect visitors.

7. DAMPIERA ERIOCEPHALA, De Vr.

I have seen only dried specimens of this species. The plant is remarkably hairy, being clothed, even on the leaves, with long silky hairs, which are all simple, and usually pure white. The tube of the corolla is bright yellow, and has guiding ridges. The auricles are well developed (Fig. 19), and deep purple in colour. They have trichomes (Fig. 18) on the posterior margin, as in *D. stricta*. These are felted together at their bases, and there are deep crimson, the free extremities being pink. Outside of these the long silky hairs of the calyx are tangled together. The indusium is dark coloured, but the style below is yellow. The remarkable feature is that the indusium consists of very short cilia, so that the stigma is exposed to the touch of any insect forcing the auricles apart. From this circumstance it is very well adapted for insect-fertilisation, resembling *D. linearis* and *D. luteiflora* in this respect. I found all the stigmas I examined coated with pollen, though none showed any outgrowth. But from the small amount of material I had it would not be safe to infer that it does not grow out.

8. DAMPIERA LORANTHIFOLIA, F.v.M.

I have seen dried specimens only. The calyx and exterior of the corolla are thickly coated with white hairs. The petals form ridges in the tube. The auricles are very complex, and very rich

crimson. The indusium is deep, two-lipped and dark red. The stigma was not outgrown in any flowers I had, and pollen was present in every instance.

9. DAMPIERA JUNCEA, Benth.

I have seen only a dried specimen, which was hairy all over, although in *Flora Australiensis* it is described as "glabrous except the flowers or the young shoots, white tomentose." In the one flower which I have had an opportunity of seeing the corolla was missing, but it is described by Bentham as rather large. The indusium was remarkable for its small size, being little greater in diameter than the style; the stigma was outgrown in a crescent. Neither indusium nor style was coloured. From the outgrowth of the stigma, it is evidently adapted for fertilisation by insects. But it is scarcely safe to infer that the stigma is always outgrown, as, in even *D. Brownii*, it sometimes does so, and in this instance it might be an exceptional case which presented itself.

10. DAMPIERA ADPRESSA, A. Cunn.

Covered with long silvery hairs in all parts; these, however, disappear from the leaves as they grow older. The auricles are well developed. The indusium is deep, and two-lipped. The lips flatten over the stigma when the cup is filled with pollen. No outgrowth was seen in any flowers examined. This appears to fall within the group in which self-fertilisation occurs more usually than cross-fertilisation.

11. DAMPIERA LANCEOLATA, A. Cunn.

The plant is hairy, the hairs on the calyx and exterior of the corolla being branched. The corolla is purple, the tube being yellow, and this colour extends to the wider part of the petals so that there is a very decided eye. The margins of the petals in the tube are ridged to form guiding lines. The auricles are well developed, resembling those of *D. stricta*, and, as in that species, there are trichomes on the posterior margins, which are not,

however, deeply coloured. The colour is very deep purple. The indusium is two-lipped, and in mature flowers closes, except for a small central opening. In all the older flowers I examined the indusium was full of pollen, and the auricles lined with a sheet of adhering grains. The indusium and stigma are purple, the style below green. In no instance did I see the stigma outgrown, or even so near the opening as to be capable of receiving pollen from a visiting insect, so that this species also falls within the group not fully adapted for insect-fertilisation; this is therefore another species with arrangements for fertilisation complete except at one point.

Summing up, it appears that in *Dampiera* there is a complex mechanism directed towards the accomplishment of cross-fertilisation by insects, and yet most species examined stop short of completeness, from the stigma's not growing out so as to be exposed to the touch of pollen-laden visitors. Those examined may be divided into two groups; those having either a shallow indusium so that the stigma may be reached by insects; and those in which the indusium is deep, and from the stigma's not growing out, incapable of being insect-fertilised. In the first of these groups are *D. linearis*, sp. (?), *eriocephala* and *juncea*; in the latter *D. Brownii*, *stricta*, *luteiflora*, *Linschotenii*, *loranthifolia*, *lanceolata*, and *adpressa*.

The various species I have examined show a gradation in the completeness of adaptation of the various parts. Thus in the auricles there is a progression from the simple fold with a slight hollow in the centre (*D. linearis*) to the most complex arrangement of folds, hairs and trichomes as in *D. stricta* and *D. Brownii*. And in those species which show this gradual increase of adaptation, there is also a regular augmentation of colour in the auricles, from the simplest with a patch of faint colour in the centre, to the deep purple spread all over the auricle in the most complex forms. This is also the case in the style, which varies from green to purple, and the indusium, from pale red to purple. The stigma is always coloured, in which the genus differs from almost every other member of the order. The indusium also varies from the

shallow and simple ring of cilia to the perfectly closed and protected cup in *D. Brownii*, or *D. stricta*. This makes the fact that the simplest and most open indusium (which may be looked upon as the ancestral form of the genus or near it) is the more remarkable, as it is best adapted for pollination by insects.

Grant Allen points out [4] that a high development of flower usually goes with a reduction of the number of carpels or seeds, because the plant is certain to be fertilised and so the seeds more likely to arrive at maturity. This theory would appear to be supported by *Dampiera*. The theory, strongly advocated by the same author, that blue denotes the highest development in a family, agrees well with the facts. *Dampiera* is certainly one of the highest developed, if not the very highest, of the order, and as already pointed out blues and purples prevail in the genus. The auricles, too, which are the most highly differentiated organs, show the greatest depth of colour, and as this colour is hidden from insects and cannot be intended as an attraction, I think it may be fairly inferred that it is a concomitant of the high development. It is significant that the indusium, and the auricles, when present, in other members of the order, often show deep tints of brown, red, and purple.

The pollen of all the species examined was small, round, and after exposure to the air, dusty, and so is well adapted for falling from the auricles in a shower on a visitor.

The genus, I think, gives a clue to the purpose of the hairs on the style, and the exterior of the indusium (not the cilia, which have a well defined function as pointed out in a previous paper [5]) in the plants of the Goodeniaceæ. They occur in *Velleya*, *Goodenia*, *Scævola*, *Selliera*, *Leschenaultia*, and, slightly, in *Brunonia*. Now in all these the style is wholly (or in those species with auricles, partly) exposed to the air, rain and dew. But the drops collecting in the flower are prevented by the hairs from reaching the indusium and thus damaging the pollen, or clogging it so that it could no longer fall freely. Even in those which have auricles, rain falling on the style would run along to the indusium but for the hairs. But in *Dampiera* only, the whole

style and indusium is closely—very closely—boxed up between the auricles, and the line of junction covered by a closely pressed clothing of hairs. It is possible that the trichomes on the posterior margins of the auricles of *D. stricta*, *D. eriocephala*, and *D. lanceolata* subserve the same purpose. At any rate, I think that the hairy styles occurring in flowers which are open to rain, &c., and the glabrous ones in those which are perfectly protected, is something more than a coincidence.

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- (3) BENTHAM, G. "Note on the Stigmatic Apparatus of *Goode-noviæ*," *Journ. Linn. Soc. Botany*, Vol. x. p. 205.
- (4) ALLEN, GRANT. "Colours of Flowers," *Nature Series*, 1882, pp. 38 and 39.
- (5) HAMILTON, A. G. "Notes on Methods of Fertilisation of *Goodeniaceæ*," Part I. *P.L.S.N.S.W.* (2), Vol. ix. p. 201.

EXPLANATION OF PLATE.

Dampiera Brownii, F.v.M.

- Fig. 1.—Top of style in early bud; *a*, from above.
 Fig. 2.—Indusium when fully developed.
 Fig. 3.—Guiding ridges in corolla.
 Fig. 4.—Young auricle.
 Fig. 5.—Mature auricle.

Dampiera stricta, R.Br.

- Fig. 6.—Indusium open, from above.
 Fig. 7.—Indusium closed, side view.
 Fig. 8.—Trichomes on edge of auricles.
 Fig. 9.—Calyx hairs.
 Fig. 10.—Auricles, showing trichomes.

Dampiera linearis, R.Br.

Fig. 11.—Indusium showing stigma.

Fig. 12.—Auricle.

Dampiera sp. (?)

Fig. 13.—Auricle.

Dampiera luteiflora, F.v.M.

Fig. 14.—Hairs from calyx.

Fig. 15.—Auricle.

Fig. 16.—Indusium.

Dampiera eriocephala, De Vr.

Fig. 17.—Indusium.

Fig. 18.—Trichomes.

Fig. 19.—Auricle.

Dampiera Linschotenii, F.v.M.

Fig. 20.—Auricle.

Fig. 21.—Top of indusium.

ON A FOSSIL MAMMAL ALLIED TO *HYPSIPRYMNUS*,
BUT RESEMBLING IN SOME POINTS THE
PLAGIAULACIDÆ.

BY ROBERT BROOM, B.Sc., M.B., C.M.*

(Plate xxv.)

* This paper, by permission of the Council, has been withdrawn, to allow of the incorporation of observations on some important, and in some respects more perfect, material discovered shortly after it was read. The new paper will appear in a later Part of this Volume. Plate xxv., in illustration thereof, is held over for the present.—ED.

ON SOME NEW OR HITHERTO LITTLE KNOWN
LAND SHELLS FROM NEW GUINEA OR
ADJACENT ISLANDS.

By C. F. ANCEY, ADMINISTRATEUR-ADJOINT, DRA-EL-MIZAN,
ALGERIA.

(Communicated by C. Hedley.)

(Plate XXVI.)

Some time ago I received from a German dealer, under probably unpublished names, the following land shells belonging to the Papuan fauna. Although the exact localities of most of them are unknown, they are, I think, from the German possessions of New Guinea.

1. PAPUINA HEDLEYI, E. A. Smith.

(Fig. 1.)

Helix (Geotrochus) Hedleyi, Smith, Journ. of Conchology, Vol. vii. 1892, p. 72, = *Helix Canefriana*, Dohrn, Cat. Staudinger (unpublished).*

I take the opportunity of giving a figure of this little known and very remarkable form from a specimen in my possession. Smith's description applies perfectly well to it, and the dimensions given are just the same. My unique specimen appears, however, to be of a darker colour, and the aperture is dark within; the tuberculous columella is stained with pale violet or white in this example, and the infra-sutural line is conspicuous in the penultimate whorl as well as on the last, but fades on the upper ones. I failed to detect any spiral impressed lines on the surface of the

* This synonymy is supported by Sykes. Journal of Malacology IV. p. 51 [C.H.]

body whorl, which is, as Mr. Smith remarks, an individual rather than specific character.

Loc.—(German?) New Guinea, *fide* O. Staudinger.

Judging from its affinities, Mr. Smith declared it to come from New Guinea; this statement is confirmed here.

2. PAPUINA TUOMENSIS, n.sp.

Helix Tuomensis, Bttg., Cat. Staudinger (unpublished?).

(Plate xxvi., Fig. 3.)

Testa imperforata, depresso-conica, subtrochiformis, sat tenuis, nitida, superne tenuissime spiraliter striata, prope aperturam lineis obsoletis et parum regularibus, antrorsum oblique descendentibus exarata, subtus lineis spiralibus undulatis exiliter rugosa. Spira late conica, summo levi, obtuso, concolore. Anfractus $4\frac{1}{2}$, convexi, sutura lineari, parum impressa; ultimus magnus, rotundatus, initio vix subangulatus, infra convexus, antice breviter et subito deflexus. Apertura obliqua, sinuata, diagonalis, nigrolimbata, margine supero sinuato, tum extus impresso et interne late subtuberculato, extero obtuse rostratim producto, columellari lato, appresso, oblique in lineam rectam inflexo, ad finem obsolete tuberculifero. Peristoma reflexum, nigrum (pariete aperturali albo). Supra griseo albida, dehinc in penultimo anfractu alba, deinde flavida, circa umbilici regionem albescens. Ultimus anfractus atro-castaneo bizonatus in medio, zona supera in penultimo prolongata, præterea fascia exiliore suturali ejusdem coloris exornatus.

Diam. maj. $23\frac{1}{2}$, min. $18\frac{1}{2}$, alt. 15 mill.

var. HETEROCHROA.

(Plate xxvi., Fig. 4.)

Paulo minor (diam. maj. $22\frac{1}{2}$, min. $18\frac{1}{2}$, alt. $15\frac{1}{2}$) et globosior, lineis tantum incrementi obliquis obsolete striatula, multo nitidior, micans; superne pulchre roseo-purpurea; ultimus anfractus læte flavidus medio basique albicans, præter vestigium fasciæ suturalis et maculis duabus castaneis prope aperturam efasciata, his, sicut

ac in typo, in apertura transmeantibus. Paries aperturalis pallide roseus.

var. VIOLACEO-FLAVA.

Præcedenti statura forma et absentia sculpturæ similis, sed typo fasciis vicina. Superne atro-violacea, dehinc pallidior, denique late flava, fasciis 2 periphericis ornatae, supera latiore, suturali prope aperturam tantum conspicua, mox evanescenti. Paries aperturalis et pars ultimi infra purpureo tincta.

Loc.—“Tuom,” probably in German New Guinea, or Bismarck Archipelago. From the same locality I received at the same time *Helicina suprafasciata*, Sowerby.

Shell imperforate, trochiform, rather thin. Spire conic, obtuse. Whorls less than 5, convex, regularly increasing, suture linear, simple; the last one large, rounded at the periphery. Sculpture faint, obsolete growth lines slightly decussated by fine crowded lines, spirally impressed above and below (where they become somewhat wavy and irregular), and obliquely running towards the aperture on the upper part of the last whorl. Surface more shining in the varieties, differing also from the type in being entirely smooth or nearly so, the only sculpture consisting in obsolete growth lines, and in colour. The whorls also appear to be a trifle more convex. Colour (in the type) greyish above, fading into milky white and finally into intense yellow on the last whorl; the latter is, on its middle, ornamented with two broad chestnut-black zones, the upper one extending on the penultimate whorl; painted besides with a finer sutural band of the same hue, also ascending on the penultimate. All these bands are conspicuous in the interior of aperture. The latter is diagonal, shortly and abruptly deflected in front. Lip intense black, reflected, roundly beaked at the periphery, flexuous above, then dented without and somewhat tuberculate within. Columella broad, adherent to the base, very slightly tuberculous at the end on the inner edge.

This interesting novelty belongs, like the following species, to the group of *Papuina Tayloriana*, Ad. and Reeve, but is destitute of any carina on the last whorl, and recalls to mind *Papuina*

Millicenta, Cox, from the Louisiades, which has nearly the same form, but not the same style of colouring.

3. PAPUINA KUBARYI, Möllendorff.

Helix Kubaryi, von Möll., Cat. Staudinger.

(Plate XXVI., Fig. 5.)

Testa imperforata, depresso-conica, subtrochiformis, modice solida, subnitida, undique tenuissime rugulosa, rugulis, irregularibus, infra dispositionem spiralem præbentibus. Spira late conoidea, summo minuto, obtuso, lævi. Anfractus $4\frac{1}{4}$, convexi, sutura lineari impressaque divisi, celeriter accrescentes, ultimus magnus, rotundatus, initio obscure angulatus, infra convexus, antice haud abrupte deflexus. Apertura obliqua, sinuata, extus rostrata (rostro sat minuto, erecto obtuso), nigrolimbata, diagonalis, margine supero leviter lateque sinuato, tum extus subimpresso, dehinc in rostrum prolongato; columellaris appressus, mediocris, oblique in lineam rectam declivis, haud tuberculatus, cum basali arcuato absque angulo junctus. Peristoma supra anguste, basi magis reflexum et expansum, atrum. Paries aperturalis violaceus. Apex nigro-violaceus; anfractus supremi grisei, inferne (ad suturam) late purpurei, penultimus pallide stramineus, punctis et lineis griseo-pellucidis adpersus; ultimus prope aperturam pulchre luteus, pone peristoma carneo-rubellus, seriebus 2 punctorum seu macularum nigrorum in fascias dispositis et plus minusve in penultimo evanescentibus egregie picta. Faux fuscula, fasciis transmeantibus.

(a) Diam. maj. 25, min. 19, alt. 16 mill.

(b) Diam. maj. $23\frac{1}{2}$, min. 18, alt. 15 mill.

var. ALBIDA.

Testa lactea, concolor, peristomate albo, griseo exiliter rare passimque substrigata vel punctulata, cæterum typo simillima.

Diam. maj. 25, min. 20, alt. 17 mill.

Loc.—(German ?) New Guinea.

This very pretty and interesting *Papuina* is evidently very close to Mr. Brazier's *Helix Gorenduensis* (Proc. Linn. Soc. New South Wales, 3rd April, 1886, p. 841), and I first thought they might be identical. However, *Papuina Kubaryi* has not 5 whorls, and, judging from Mr. Brazier's description, also differs in several other particulars. No mention is made by the latter of the disposition of the small spots, which, in *Gorenduensis*, are "pinkish," not grey nor blackish towards the aperture. Mr. Brazier says his shell is "flesh-tinted a cream colour," while *Kubaryi* is yellowish cream-colour, reddish-pink behind the peristome. The aperture, in this, is intense black on the lip, violet-purple on the parietal margin, and purple-brown within the throat, while in *Gorenduensis*, "the interior is bright pink, the peristome blackish-purple," and the "margins joined with a thin pink callous entering spirally into the interior of the aperture." I therefore suppose the two species are really different from each other.

4. HEMIPLECTA GRANIGERA, n.sp.

Testa subsolida, depressa, orbiculata, aperte umbilicata, oblique confertim striata et undique minute spiraliter granulata (granulis in ultimo validioribus, circa umbilicum magis obsoletis), vix nitida, sordide fusca, medio obtuse angulata, infra angulum zona obscuriore per testam conspicua diffusaque cincta, subtus pallidior. Spira depresso-conoidea, obtusa. Anfractus 6 subconvexi, sutura parum profunda, simplici; ultimus haud descendens, superne et praesertim infra angulum medianum obtusum pallidum convexus. Apertura ampla, obliqua, lunata, transverse subovalis. Peristoma simplex, acutum, rectum, marginibus remotis, callo tenui nitido concolore junctis, margine columellari late arcuato, vix expansiusculo, umbilicum (pro genere magnum, anfractus omnes ostendentem) nullomodo obtegente.

Diam. maj. 43, min. 35, alt. 22 mill.

Loc.—(German?) New Guinea.

This species should perhaps be referable to *Rhysota*, but is more nearly related, from the general appearance of the shell, to

such *Hemiplecta* as *Blainvilleana*, *Humphreysiana* and *Fouilloyi*. I received it under the latter name, but it is certainly utterly distinct. The *Fouilloyi* is a large and more globose shell, more narrowly umbilicated. In this respect the present shell is more like *Rhysota Achilles*, Braz., but is smaller, has a thin aperture and more numerous volutions. The sculpture may be the same in both species.

5. PUPINA BEDDOMEI, n.sp.

Pupina Beddomei, Bttg., Cat. Staudinger.

Testa ovata, tenuis, pallucida, hyalina, nitidissima, griseo-albicans. Spira oblonga, obtusiuscula; anfractus 6 levissime convexi, sutura callosa zona exili pellucida cineta divisi; ultimus descendens, ad aperturam breviter ascendens, antice subdepressus. Apertura basi antice protracta, rotundata, bicanaliculata, scilicet; canali supero peristomate non extus exciso et lamina parietali arcuata sat valida intrante constituto, et canali altero ad basin columellæ excisæ, extus in foramen rotundatum terminato. Peristoma intus incrassatum, leviter patulum.

Long. 7, diam. $3\frac{1}{2}$; long. apert. $2\frac{2}{3}$ mill.

Loc.—Bismarck (or New Britain) Archipelago.

This species is more slender than *Pupina speculum*, Tapparone-Canefri (Fauna Malac. Della Nuova Guinea, 1883, p. 270, Pl. x. figs. 14-15), and indeed more nearly related to *Pupina difficilis*, Semper, of the Pelew Islands. From the last named species it differs in being a trifle larger, light ash-coloured, and chiefly in the characters of the aperture, which is vertical in *difficilis*, also furnished with a more robust superior lamina and more excised columellar margin in *Pupina Beddomei*. The same characters, although not very striking, will also without much difficulty distinguish *Pupina Beddomei* from the *complanata*, Pease, which occurs in the Kingsmill and Caroline groups. They are very constant in the several specimens before me.

I am happy to give this species the name of my distinguished correspondent Mr. C. E. Beddome.

6. *CYCLOPHORUS KUBARYI*, Möllendorff.*Cyclophorus Kubaryi*, v. Möll., Cat. Staudinger.

(Plate xxvi., Fig. 6.)

Testa solida, opaca, rugosa, parum nitens, turbinato-globosa, profunde sed (pro genere) minute umbilicata, umbilicus ad terminationem leviter excentricus, superne atro-fusca, in medio ultimi anfractus luteo plus minusve distincte bifasciata, subtus circa umbilicum flava vel pallida. Spira conoidea, elevata, obtusa. Anfractus $5\frac{1}{4}$, convexi, sutura infra subirregulari discreti, haud valde turgidi; ultimus relative (pro genere) parum amplus, rotundatus, altus, prope aperturam leviter subdeflexus. Apertura subobliqua, fere circularis, ad insertionem subangulata, extus leviter sinuata, sordide lutea. Peristoma acutum, haud expansum nec reflexum, vix patulum, ad columellam paulo magis incrassatum et expansiusculum, umbilicum haud tegens. Lineis incrementi sub lente irregulariter exarata et rugis undulatis ad apicem evanescentibus, basi tenuioribus peculiariter et eximie sculpturata, quasi vermiculata. Operculum tenue, rubellum, multispiratum, centro minute concavum.

Diam. maj. 28, min. 23, alt. 24, alt. apert. 14 mill.

Loc.—(German ?) New Guinea.

There is no form known to me that I might compare with this. The operculum is red, thin and cyclophoroid, while the shell itself resembles in shape, as far as I can suppose from the figure given by Mr. M. M. Schepman, *Cyclotus Soembaensis*, of the Island of Soemba (Indian Archipelago). The description of the latter applies nevertheless to a true *Cyclotus* of the section *Pseudocyclophorus*, Martens. (See Notes from the Leyden Museum, Vol. xiv. p. 158, Pl. 6, fig 3, 1892.) The remarkable sculpture of *Cyclophorus Kubaryi* is quite peculiar for the genus as well as the general "tout ensemble" of the shell, and the simple, not reflected, lip. The former, obsolete beneath, is very much marked above, and recalls that of *Helix Quoyi* and *mamilla*, although it may be termed as more vermiculous. The whorls are more tightly

coiled and the apex more globular, less mamillar than in any *Cyclophorus* I am acquainted with. No shell from New Guinea is like this, and I feel confident altogether that when the animal is known it may be considered the type of a new genus. Provisionally, a sectional name may be given to it, and I should propose for this object that of *Papuocyclus*, as the only species known till now of this section belongs to the Papuan fauna. To my knowledge the large typical *Cyclophori* are still unknown from New Guinea or neighbouring isles.—Algeria, Feb. 1st, 1895.

EXPLANATION OF PLATE.

Fig. 1.—*Hemiplecta granigera*, Ancey.

Fig. 2.—*Papuina Hedleyi*, Smith.

Fig. 3.— „ *tuomensis*, Ancey.

Fig. 4.— „ „ var. *heterochroa*, Ancey.

Fig. 5.— „ *Kubaryi*, Möllendorff.

Fig. 6.—*Cyclophorus Kubaryi*, Möllendorff.

Note by C. Hedley.

About the date on which I received the manuscript of the above, there reached me an article by Dr. O. von Möllendorff, "On a Collection of Land Shells made by Mr. I. Kubary in German New Guinea," Proc. Malac. Soc. Vol. I. Pt. V. Pl. xv. pp. 234-240. Dealing with similar material, Mr. Ancey's paper has been partially anticipated by the prior descriptions of *P.* and *C. Kubaryi*. Since, however, Mr. Ancey's independent observations extend beyond those of his predecessor, and since the intervention of time and space do not allow me to refer the paper back to the author, I have judged it best to offer it intact to the Society.

PLANTS OF NEW SOUTH WALES ILLUSTRATED.

No. viii.—ACACIA LANIGERA, A. Cunn.; B.Fl. ii. 324.

By R. T. BAKER, F.L.S., ASSISTANT CURATOR, TECHNOLOGICAL MUSEUM, SYDNEY.

(Plate XXVII.)

A rigid shrub of several feet, the branches terete, branchlets often angled and mostly woolly.

Phyllodia lanceolate, falcate, rigid, thick, dark green, tapering to a pungent point, $1\frac{1}{2}$ to rarely $2\frac{1}{2}$ inches long, mostly 2 to 3 lines rarely 4 lines broad, in some specimens woolly but in others glabrous; nerves very prominent, occasionally anastomosing, marginal gland rarely found, except in southern specimens.

Stipules subulate, about $1\frac{1}{2}$ lines long, often persistent, woolly.

Peduncles axillary, short, weak, solitary, clustered, bearing a globular or elongated head of about 25 flowers, mostly 5-merous.

Bracts at the base of the peduncles ovate, acuminate, ciliate, woolly.

Calyx campanulate, with obtuse, thickened, ciliate lobes, not half as long as the corolla.

Petals smooth, united to the middle.

Pod about 3 inches long, 3 to 4 lines broad, very woolly, much twisted, margins not thickened, slightly contracted between the seeds.

Seeds longitudinal, oblong in the centre of the pod, the funicle short, with 3 folds, the last fold short, but not thickened under the seed.

Hab.—Coonabarabran, (S. Lyndon), Mudgee and Rylstone (R. T. B.); Cobar (Rev. J. M. Curran); Blue Mountains, Lachlan River and to Southward (A. Cunningham, Fraser, Huegel, Mitchell and others, *teste* Bentham).

I feel privileged in being able to complete the description, and to give a satisfactory figure of this species, and I hope now that these notes will remove any difficulties that may have existed in connection with its determination.

I have not seen A. Cunningham's description in Field's Geographical Memoirs on New South Wales, but I take it that Don's transcription of it is a correct one, judging from the numerous specimens that have come under my observation, and the very brief description of the pod is correct as far as it goes.

In the Bot. Mag. t. 2922, published in 1829, no pods are figured or described; and the illustration itself is of very little help in identifying the species.

Bentham's description of the pod in the Flora Australiensis (Vol. ii. p. 325) is referred to by Baron von Mueller in Proc. Linn. Soc., 2nd Series, Vol. v. p. 19, in these words:—" . . . Bentham placed the pods of *Acacia Oswaldi* with *A. lanigera*" so that this error has perhaps been the cause of the recent confusion surrounding this species, and a debt is due to Baron von Mueller for so important a note.

But to me it appears that Bentham must have had some pod other than *A. Oswaldi* before him, as the description under *A. lanigera* does not agree with the pod of *A. Oswaldi* in Baron von Mueller's Iconography of Australian *Acacias*, 6th Decade, and which figure agrees in every detail with all specimens of the fruit of *A. Oswaldi* that have come under my notice.

In Baron von Mueller's note above quoted he gives *A. venulosa* and *A. Whanii* as synonyms of this species.

This latter species I have not seen, but from the imperfect specimens of *A. venulosa* collected by me, I am inclined to think that *A. venulosa* of Bentham is a good species.

EXPLANATION OF PLATE.

Plate XXVII.

ACACIA LANIGERA, A. Cunn.

- Fig. 1.—Flowering twig.
Fig. 2.—Part of a branch enlarged, to show bracts and stipules at the base of the peduncle.
Fig. 3.—Bud.
Fig. 4.—Expanded flower.
Fig. 5.—Pistil.
Fig. 6.—Cluster of pods.
Fig. 7.—Seed *in situ*.
Fig. 8.—Individual phyllode.
Fig. 9.—Portion of phyllode enlarged.
(Figs. 2, 3, 4, 5 and 9 enlarged.)

DESCRIPTION OF A NEW SPECIES OF ACACIA
FROM NEW SOUTH WALES.

BY J. H. MAIDEN, F.L.S., AND R. T. BAKER, F.L.S.

ACACIA PUMILA, sp. nov.

(Plate xxviii.)

A diffuse, virgate, *pubescent* shrub under a foot high as far as seen; branches and branchlets terete. Phyllodes narrow, falcate, tapering into a recurved pungent point, narrowed at the base, trinerved, *not decurrent as in A. trinervata*, and less articulate, 6 lines long and 1 line broad, with scattered glandular hairs on nerves and edges. Stipules *prominent*, subulate, hairy, over 1 line long. Peduncles silky-hairy, short, scarcely 2 lines long, recurved, solitary, bearing a small head of not more than 10 flowers mostly 5-merous. *Calyx more than half as long as the corolla, with acute almost subulate lobes, prominently ribbed especially in the bud, ciliate.* Petals narrow, *free*, glabrous, *very* prominently ribbed, very marked in the bud. Pod 1 line broad, 12 lines long as far as seen, slightly contracted between the seed, margins thickened. Seeds oblong, longitudinal; funicle dilated from the base into a club-shaped aril and consisting of about 4 folds.

Hab.—Kenthurst (R. Helms).

Systematically this species approaches *A. trinervata*; but it is a much *smaller shrub*, with a *pubescence* on the branches and underside of phyllodes; and the phyllodes are smaller, also falcate (not rigid) with recurved points, and slightly pubescent; the peduncles are also much shorter and weaker, and there are fewer flowers in the heads. The characters of the calyx and petals are entirely distinct from those of that species.

The ovary is also hairy, and the stipules which are minute in *A. trinervata* are very distinct in this species. The phyllodes and the shortness of the peduncles give it some affinity to *A. lanigera*. It differs from both, however, in the size of the pod.

It belongs to the *Pungentes* series of Bentham, and sub-series *Plurinerves*, viz.:—Phyllodia 2- or more nerved, linear-lanceolate.

Peduncles short. Pod 4 to 5 lines broad... *A. lunigera*.

Peduncles mostly recurved, 1-2 lines long.

Pod 1 line broad *A. pumila*, n.sp.

Peduncles slender, $\frac{1}{2}$ inch long. Pod 1 to 2

lines broad..... *A. trinervata*.

EXPLANATION OF PLATE.

Acacia pumila.

Fig. 1.—Flowering twig of plant.

Fig. 2.—Fruiting twig of plant.

Fig. 3.—Bud.

Fig. 4.—Individual flower.

Figs. 5 and 6.—Bracts.

Fig. 7.—Pistil.

Fig. 8.—Phyllode magnified.

Fig. 9.—Pod.

Fig. 10.—Seed with arillus.

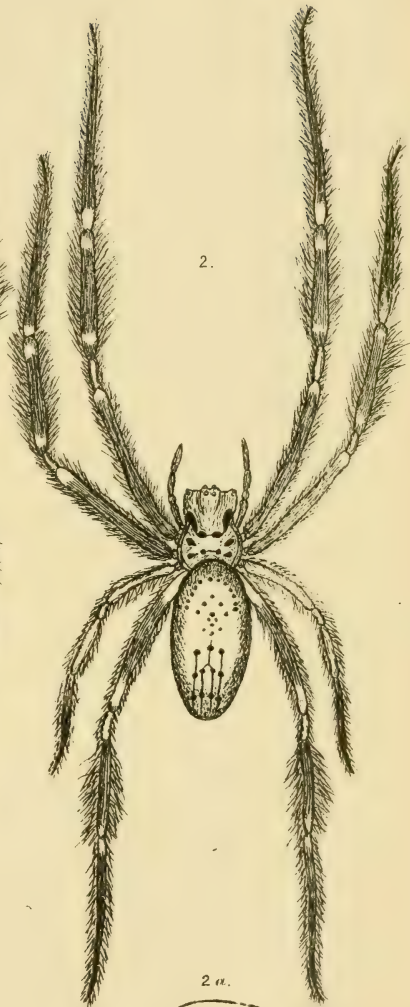


R.T. Baker, del

ACACIA BAKERI J.H. Maiden.



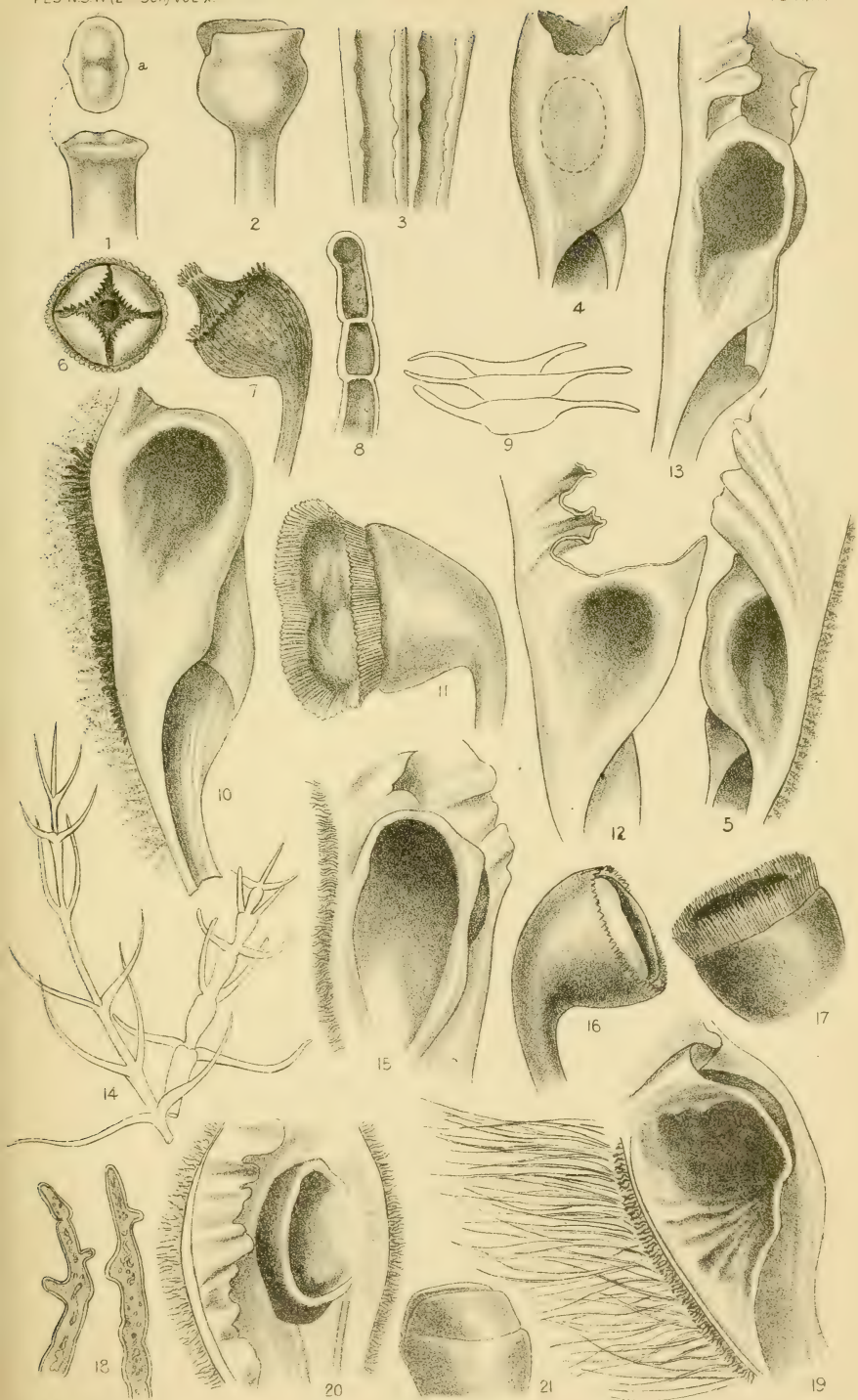
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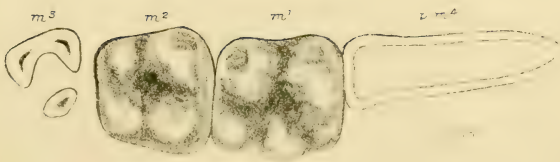
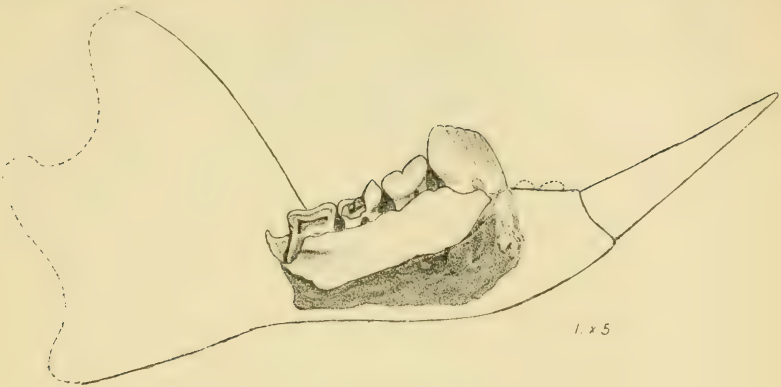
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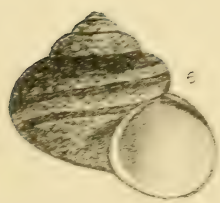
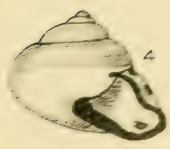
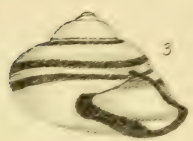
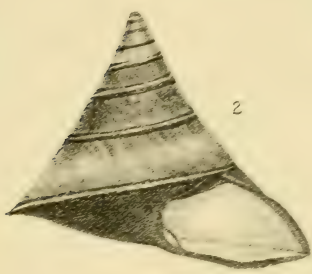
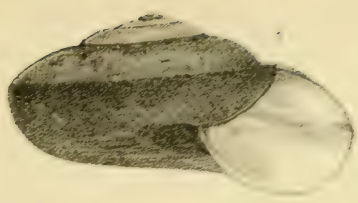
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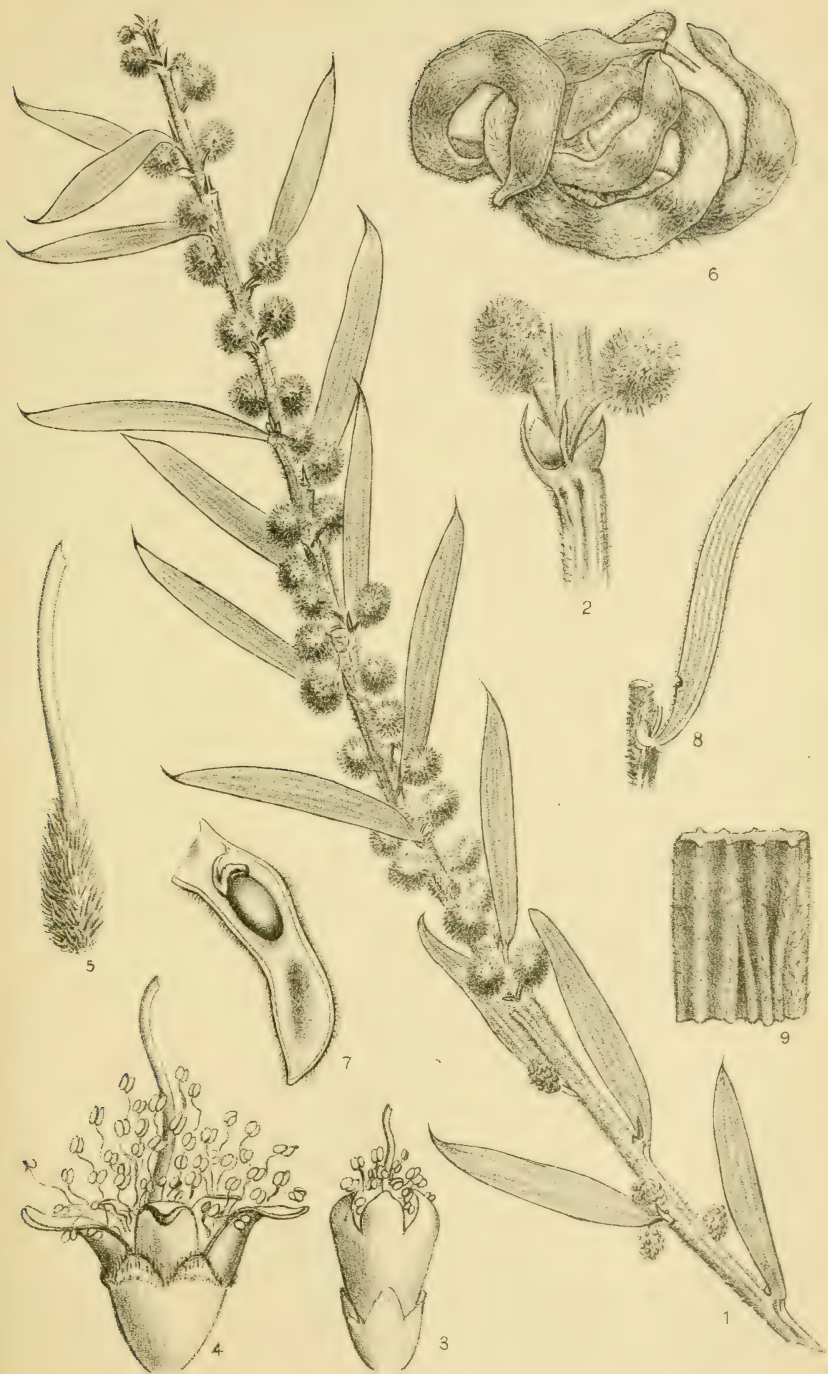




A.G.H. del. ad nat.







R.T. Baker del.

ACACIA LANIGERA, A. Cunn.



RT Baker del

ACACIA PUMILA Maiden et Baker



ANTHROPOLOGICAL NOTES.

BY RICHD. HELMS.

(Communicated by the Secretary.)

(Plates xxix.-xxx.)

INTRODUCTORY REMARKS.

The following notes are to a great extent compiled from communications I have from time to time received from old settlers who in their early days frequently came in contact with the Aborigines inhabiting the neighbourhood of their settlements, and who remember the habits and customs of these extinct or decaying tribes. Special thanks I owe to Mr. John Barry, Senr., who settled on the Mowamba River more than forty years ago, and from whose store of vivid recollections I have drawn a great many of the facts now set down.

It is to be regretted that the narratives are but fragmentary, yet I consider them sufficiently interesting to be recorded, more especially on account of the comparisons that may be drawn between the manners described and those of other Australian tribes.

I do not intend to dilate upon this subject, but merely wish to remark that, viewing the manners and customs described from a general aspect, it becomes apparent that they are very similar, and that they originated in common with those of the great bulk of the other Australian aboriginal tribes. The tribes here spoken of differed from most of their compatriots in the neglect of some widespread customs rather than in the practice of peculiar rites. I am alluding to the rites of circumcision and of the mika operation, neither of which were practised by the tribes that lived in the

south-western parts of New South Wales or the north-eastern of Victoria.

THE OMEO BLACKS.

This tribe, once numbering upwards of 140 to 150 souls, is now extinct. They can still be remembered by some of the old settlers, who not much more than 30 years ago saw them a vigorous tribe in its fullest expansion. It is a lamentable fact that through contact with Europeans within the time of one generation, whole tribes of considerable numbers have entirely vanished. This does not only apply to the tribe in question, but is equally applicable to their neighbours, whether friends or foes. The Monaro tribe, for instance, is also nearly extinct, and of their once numerous hordes only two or three half-civilised, demoralised individuals remain. Between 30 and 40 years ago some of the old settlers have seen on special occasions as many as 500 to 700 aborigines of all ages and sexes assembled together, but their grandchildren will know the blacks only from hearsay and by what remains of their less perishable implements of war, *i.e.*, a few stone hatchets that may occasionally be turned up during ploughing, or otherwise discovered.

The Omeo Tribe occupied the north-western corner of Victoria, and were friendly with the Buffalo Tribe (Ovens district) on their side of the Murray, and on the other side of the river with the Monaro and Queanbeyan Tribes. Probably the customs of these four tribes were identical, because they lived in frequent intercourse and combined against their common enemies. These were the Braidwood, the Twofold Bay, the Gippsland Tribes, and those living near the borders of the Murray from below Albury.

A nearly constant feud was waged between these tribes, and bloody contests frequently occurred. The mode of attack as a rule was as follows:—After watching the enemy during the day-time, and spying out their camping place, a couple of warriors would stealthily sneak round it at night to reconnoitre the position and its surroundings. If not detected, a raid would be made upon it at the dawn of day by the whole of the attacking party, who generally yelled loudly and made a fearful noise when close

to the camp. The surprise mostly caused a stampede amongst the suddenly aroused sleepers, and those who did not escape by immediate flight, whether young or old, would be speared or knocked down with nulla nullas. After burning the spears and other war implements that were left behind, the attacking party returned as quickly as possible to their own district, probably to meet with a similar fate at some future time when the enemy had rallied and was reinforced.

The oldest man of the tribe was recognised as a kind of chief, but whenever an attack on some enemy was planned, the ablest warrior as a rule was chosen to lead, and his advice then received the endorsement of the old men.

Personal disputes were also not infrequent, and were generally settled by a fight, either with spears or clubs. In each case the shield served for warding off the spears or the blows of the nulla. Fighting with stone tomahawks was not permitted in these duels, and was suppressed if in the heat of the combat the assailants should resort to these murderous weapons. In fact most of their fights, if single combats, were regulated by the onlookers, who frequently interfered when one of the parties was seen to get weak and it was noticed that he was unable to ward off the blows with the necessary dexterity. Some of their fights were regulated so that the combatants alternately hit the "hielaman" held by the opponents with the left hand above the head till the arm would gradually get weak and sink so that the nulla would fall on the head instead of the shield. The first hit on the head would end the fight as a rule, and frequently—if, for instance, one of the duellists was a much older man than the other—the fight might probably be stopped just before the club fell upon the skull, and the combat declared satisfactorily finished.

During the quarrel the opponents used to gather their beards in the mouth, which, together with the grimaces they assumed, gave them a ferocious expression.

They recognised the tribal rights to certain grounds, but the boundaries were not always particularly respected, as it happened frequently that they were overstepped during hunting excursions.

When about to convey important communications to another tribe, such as to summon the warriors for a hostile invasion of the territory of their common enemies, or for a friendly meeting with the object of performing rites of a ceremonial nature, &c., two men were generally sent. Whilst the one slept the other kept watch to avoid being surprised by enemies during the journey, or being taken and slain as such whilst asleep by some friendly natives in mistake.

When on the war-path, as well as during the performance of their rites of initiation and at their dances and corrobories, they liked to appear ornamented, which they accomplished by painting the fronts of their bodies. The colours used were white, red, and black. For the first they used pipeclay, for the second raddle, and for the black charred seedstalks of the grasstree. The powdered charcoal they mixed with grease, forming a pigment that would stick on for months.

They had two distinct ceremonies to raise the male members of the tribe from childhood to manhood.

At about the age of from 14 to 16 years the young man was made "Kurrunong," which was done by knocking out one of his upper central incisors. This removed him from the care of his mother and the influence of the women, and so to say raised him from boyhood to the state of youth.

At the age of 18 or 20, that is when his beard had started to develop properly, he was made "Wahu." To initiate him into this state, the following ceremony was performed by the men, the women being excluded :—All the hair of the head was singed off close to the skull by means of some burning fibrous bark. This was a somewhat slow procedure, and had to be done very gradually, the hair being lit continually and blown out before it flared up too much. Whilst the young man submitted to this in silence, the onlookers and operators would carry on a lively conversation or some chanting. When all the hair had been removed and the singing was over, three of the old men came running towards the newly initiated with green boughs in their hands, which they waved in succession several times over his head.

After this the men would run some distance away and returning swing the boughs with a swishing sound in a certain direction, mentioning at the same time the name of the district towards which they were pointing. This was repeated three times for each of the various directions they might point to. Each name mentioned was preceded by the emphasised exclamation of "Wau-Wau!" For instance, "Wau-Wau! Tumut;" "Wau-Wau! Queanbeyan," &c., &c., which was followed at times by an exhortation or malediction. This indicated that the Wahu may go to these districts as a friend and may have luck, or on the other hand that in some of these directions lived the tribes with whom he would have to carry on the hereditary feuds, for from henceforth he was to be considered as being raised to the position of a warrior in his own tribe.

As soon as the initiation was completed, the women were again admitted to the presence of the men, and dancing and corroborries were held during the evening for the amusement of all, and more particularly for the benefit of the visitors, of whom there were generally a number present on these occasions.

Manhood having now been conferred upon the newly initiated, the respect due to a man (which meant a warrior in case of need and not a mere huntsman as hitherto) was shown him, and in commemoration of the event a special privilege was accorded to him. This consisted in the permission being given to the newly made Wahu to choose any woman of the tribe he liked, his blood relations excepted, and cohabit with her for the night. But such a privilege was extended to him for that night only. At any other time sexual intercourse was regarded as adultery or fornication, as the case might be, the punishment for which was a severe beating with waddies, sometimes inflicted with sufficient severity to cause death.

They had no special marriage ceremonies, but when a woman was to be given to a man to cohabit with him for the first time, her female relations and the other women of the tribe would build a "gunyah" of boughs, dense enough to prevent being overlooked,

and place the woman therein to wait the arrival of her affianced man.

A girl was frequently betrothed to someone by the parents at her birth, and was handed over to her affianced man when she arrived at puberty.

Polygamy was customary and was not restricted; the more wives a man had, the richer he was considered.* As a rule the women were a free gift, but at times a remuneration had to be offered in the shape of weapons or other useful utensils. The man who had a number of sisters whom he might promise, or over whom he possessed some influence through his parents, stood the best chance of having many wives.

It was not considered adultery for a brother to have sexual intercourse with the wife of a brother, and it would frequently occur that one brother would lend a wife to another who had none of his own. During the absence from the district (when, for instance, on a visit to a friendly tribe) the wife or wives were left in charge of a brother who assumed the part of husband for the time being. If the absentee had no brother, this duty would fall upon the nearest relative. The husbands of two sisters were considered to be brothers.

Marriage between blood relations was strictly forbidden. They firmly believed that if closely related people had carnal connection, both offenders would be bitten by "jidjigongs" (snakes); this was a constant dread to them, as it might not take place till after many years.

The same punishment was also supposed to follow looking at or speaking to mothers-in-law, which was forbidden before as well as after marriage.

Young people were strictly forbidden to indulge in carnal intercourse. If detected at such an offence, they would receive a severe beating from the other members of the tribe. In case a

* My informant (Mr. Barry) told me that he had known some men to have as many as five wives.

woman of mature age should have clandestine connection with a much younger man than herself, she was sometimes killed.

Whenever adultery was discovered, the punishment was in most cases death. The woman's friends as a rule attacked the offending man, and the man's friends killed the woman. Although this was the generally adopted custom and law, it was often the cause of a general intertribal fight and the origin of a prolonged family feud.

A man who received a girl in promise endeavoured to obtain a lock of her hair, which he would keep, and if she refused him afterwards he would sometimes wrap an eagle-hawk's feather in the hair and throw the tuft in some waterhole. As the hair decomposed, the woman would sicken and ultimately die.

Up to about the fourth year a child got almost anything it liked to eat, but at a later age it was forbidden certain things. They were made to believe that if anyone ate of forbidden food he or she would sooner or later be killed by lightning. This superstition was so firmly ingrafted into them that some would endure severe starvation rather than partake of forbidden food. From some individuals the restriction of eating certain animals was removed earlier than from others, but it seems that the flesh of an emu was never allowed to be eaten till some time after the arrival at the age of manhood. When this time had arrived, the man who was for the first time to eat of this specially reserved dish would sit down between two fires and have the emu placed in front of him. He could then eat as much as he liked, but was not allowed to go to sleep when he was satisfied, and was forcibly kept awake the whole night whenever he became drowsy.

They cooked their food either on the fire, or when they had a great deal of it and were not in a hurry, in a kind of oven in the ground. For this purpose they dug a suitable hole and filled the bottom of it with stones over which a fire was lighted. As soon as the stones had been well heated, the fire and ashes were removed and the game was placed upon the stones. This was covered with bark and green bushes over which the hot ashes were heaped, and the whole left undisturbed till the meat was cooked.

The food supply was as a rule abundant in the district during favourable seasons. It consisted of all kinds of game, birds and birds' eggs, reptiles, fishes, and insects. Amongst the first the opossum furnished probably the most frequent meal, because it occurred very abundantly; and amongst the insects the "Bugong"* supplied numbers of the natives with a fattening diet for months. How this unique and remarkable food supply, found always on the highest mountains, was procured deserves a detailed description:—As early as October, as soon as the snow had melted on the lower ranges, small parties of natives would start during fine weather for some of the frost-riven rocks and procure "Bugongs" for food. A great gathering usually took place about Christmas on the highest ranges, when sometimes from 500 to 700 aborigines belonging to different friendly tribes would assemble almost solely for the purpose of feasting upon roasted moths. Sometimes these natives had to come great distances to enjoy this food, which was not only much appreciated by them but must have been very nutritious, because their condition was generally improved by it, and when they returned from the mountains their skins looked glossy and most of them were quite fat. Their method of catching the insects was both simple and effective. With a burning or smouldering bush in the hand the rents in the rocks were entered as far as possible, when the heat and smoke would stifle the thickly congregated moths, that occupied nearly every crack, and make them tumble to the bottom of the cleft. Here an outstretched kangaroo skin or a fine net made of kurrajong fibre would receive most of the stupefied and half-singed insects, which were then roasted on hot ashes. This process required some care and attention in order to prevent the bodies of the moths getting scorched, and therefore the ashes required to be not too hot and had to be free from large glowing embers. The insects were thrown upon the ashes and well mixed with them, and then the whole was stirred with sticks till the wings and legs had broken away and the body was cooked, when

* See also the note at the end of the paper (p. 406).

it generally shrivelled to the size of a grain of wheat. The mass was freed of the ashes by dropping it by degrees into some vessel or on a skin and allowing the wind to sift it; the food was still further cleansed from adhering particles of dust and other unpalatable substances by gently rubbing it between the hands, and rolling it backwards and forwards from one to the other whilst blowing from the mouth. The taste of the roasted bodies of the "Bugongs" is, according to some Europeans who tried them, sweetish and nut-like and rather pleasant eating.*

This unique food supply is restricted to the highest mountains of Australia, but here it can always be found in abundance during the summer months. It is a marvel that the highest and stoniest ridges, on which snow lies for fully five and sometimes six months of the year, with a naturally scanty though rapidly growing summer vegetation, should harbour such enormous numbers of an insect (the caterpillar of which is known to be very voracious) which was at one time the means of fattening a congregation of over 500 aborigines every season.

* After the above was written, I met with Dr. George Bennett's work, "Wanderings of a Naturalist in New South Wales, &c.," wherein the earliest account of this food supply is given. Dr. Bennett set out for "Günundery" (the "Big Bugong" Mountain) from the Upper Tumut, but he did not meet the blacks reported to camp there "Bugonging." His report is consequently from hearsay, and not from personal observation. After describing the cooking of the moths, which corresponds with the method described by me, he continues:—"They are then eaten, or placed in a wooden vessel called a Walbun, or Culibun, and pounded by a piece of wood into masses or cakes resembling lumps of fat, and may be compared in colour and consistence to dough made from smutty wheat mixed with fat. The bodies of the moths are large, and filled with a yellowish oil, resembling in taste a sweet nut. These masses (with which the "Netbuls" or "Talabats" of the native tribes are loaded during the season of feasting upon the "Bugong") will not keep above a week, and seldom even for that time; but by smoking they are able to preserve them for a much longer period. The first time this diet is used by the native tribes, violent vomiting and other debilitating effects are produced; but after a few days they become accustomed to its use, and then thrive and fatten exceedingly upon it." (Vol. i. pp. 271-272.)

The crows fattened rapidly on the moths and were also highly prized as food. They were consequently much pursued by the natives during their bugonging pic-nics.

The fine nets made of kurrajong fibre mentioned above seem to have been especially designed for the purpose of collecting the "Bugong." They had very fine meshes and were manufactured with great care, and being attached to a couple of poles they could be readily folded up when they had to be withdrawn from the crevices. A shrub, (*Pimelia* sp.) growing abundantly in places by the river sides to a height of three to four feet, furnished the fibre. The bark of this bush was stripped and allowed to dry, was then placed in water, and weighted down with some stones for several days till the non-fibrous portions were partly rotted. It was then taken out of the water and spread in the sun to dry till it was quite crisp, after which the fibre was freed by beating with sticks or flat stones. All this was the women's work, and they managed to produce a tenacious material from it that could be spun into the finest threads.*

They kindled fire by friction, and for this purpose procured two pieces of the seed stalk of the grass tree (*Xanthorrhæa*). One of the pieces was flattened and laid on the ground, and the other, pared to a point, was pressed against the flattened surface and rapidly twirled between the flat hands. The friction soon produced sufficient heat to cause some of the fine particles that were loosened by the rotatory motion at the point of contact to glow, which was, with the addition of some powdered charcoal and dry pounded bark fibre, fanned into a flame.

* Among the white people of Australia the name kurrajong is applied to a tree (*Brachychiton*), but the natives in most parts give it a different name and say that kurrajong is white fellow name. It seems to me that the tree obtained its name through a misunderstanding because it yields a fibre that is frequently used by aborigines for making nets. This fibre is called kurrajong by some natives, which seems to have led to the name being applied to the tree. On the other hand, as the Omeo blacks called their bush as well as the fibre kurrajong, such may possibly be the case with the *Brachychiton* tree in some tribal dialects.

To make a signal, a fire was lit by the side of a dry tree and green bushes were heaped upon the flames when these had made a good start. The smoke would then rise alongside of the tree as if it were forced from a furnace.*

Their habitations were simply shelters made of a few sheets of bark put against a pole on the windy side.

Their wearing apparel, for both sexes, consisted of two bundles of narrow strips of skin suspended, one in front and the other behind, from a belt round the waist. During wet and cold weather, however, they wore an opossum cloak or a mat made of kangaroo skins, which otherwise served for carrying the umigong, nulla nulla, boomerangs and hielaman in, when folded.

The belt worn round the middle of the body consisted of a number of closely laid coils of string, made of twisted opossum fur, which was from 12 to 15 feet long. To put it on, they fastened one end to a tree and holding the other end to their body they turned round and round till it was completely wound.

Over the forehead, and very tightly fastened round the head, a band about an inch to an inch and a half wide was generally worn by most of them. This was neatly plaited with fine twists made out of the bark of kurrajong, and esteemed as an adornment.

A woman having her menses would bind a string round both arms, as a sign that she was to be avoided by the men. Should she step across some stream of flowing water whilst in this state, no one would drink below the place where she crossed it. She

*It is often asserted that the natives of Australia communicate by means of smoke. By the manner in which the smoke is made to ascend and by the volume as well as by the number of columns, &c., &c., they are supposed to have formulated a generally understood system of telegraphy. No doubt they are very expert in making smoke ascend, and carefully consider the state of wind and weather, understanding how to choose the proper material (green or dry) and how to take advantage of special local features, and watch the proper time of day when the signals are likely to attract attention. But everything is done in accordance with preconcerted arrangements. No generally acknowledged code exists. In my opinion too much has been made of the supposed elaboration of a telegraphic system by means of smoke signals.

had therefore to be cautious and avoid polluting any water when travelling in company.

When about to give birth the women retired to a secluded place and usually managed the confinement without assistance from other females.

The children generally received a name after something remarkable that happened at the time of their birth or after something in connection with the locality of it.

As a rule the children were a good deal indulged and were allowed to have things their own way, but were supposed to be obedient to their parents. If they disobeyed, they were taught they would be punished during later years by getting bad rashes and sores on their body and limbs, caused through the influence of a fiendish spirit. A disease of this kind was often the cause of death amongst them. It began with an itch like a scab that was dry on the surface but festering below the skin, and at an advanced stage smelled very offensively and sometimes caused the flesh to rot away. Some who were only lightly afflicted with it would perhaps be cured, but when the disease became general and severe it was mostly fatal. As a cure the natives ate a kind of yam* cooked in hot ashes or roasted on stones, as well as other vegetable food and certain herbs.

Whenever a native became ill he imagined that "Jakkandibbi" (the supposed evil spirit) had taken his "gurai" (kidney fat). It was believed by them that they may recover from it, but if Jakkandibbi was to take the gurai the third time it would be followed by death. The blackfellow's belief was that he would live for ever were it not for the evil one who robbed him of his life; even if a spear were thrust through his heart, it would not be the spear that killed him but it would be Jakkandibbi.

* From the description received of the plant, I believe these to be the tubers of a liliaceous plant. The disease, from the description and its cure, seems to be scurvy of a severe nature, or a similar affliction, caused no doubt through unhealthy meat or want of a variety of food.

They believed that an enemy could secretly throw a "gibba" (stone) which would enter the body of the person it was to hurt and cause pain in the place it had entered.*

If therefore anyone felt a pain in the body or any of his limbs the "Karaji" (doctor or wizard) of the tribe would bite or suck the place and generally produce a stone after a few minutes which he professed to have removed from the sore part. Sometimes they even managed to show blood on the stone. As a rule, the patient would soon recover after this display of crafty fraud.

These "Karaji," besides possessing these curative powers, were supposed to be able to work all sorts of miracles and charms, but generally each of them was noted for some special power. Some, for instance, were expert in making rain. For this purpose eagle-hawk feathers were rubbed between the palms of the hands in connection with various manœuvres and gesticulations, invented and differently performed by each individual conjurer. Every one tried to inspire the onlookers with his special power and used his own methods to deceive the credulous.

The dead were buried in different ways: either in a hollow tree, if the corpse could be dropped down from the top, or in a sitting position in a hole dug in the ground, or a cavity was made at the bottom of a deep hole where the corpse was pushed in and some stone slabs placed against it before the hole was filled up. In each case the body was tied up in some fibrous bark with the knees drawn towards the abdomen and the limbs firmly lashed together. Great wailing and lamenting preceded the burial for several days; the relations, and more particularly the women, chopped and gashed their heads with stone tomahawks till blood flowed freely. When the body was disposed of, they smeared pipeclay over their heads and faces as a sign of mourning. This outward sign of sorrow was retained for some time, but as a rule much longer by the women than by the men. But as soon as the flesh of an enemy was eaten, even if this were on the day

* This superstition is evidently the same as the "pointing of a bone," believed in by most of the Australian indigenes, in another form.

following the burial, all grief was banished and the mourning signs were removed.

They firmly believed that the dead would not stay in the grave but would come to life again in another form, which might take the shape of a fish, bird or animal, or anything else; their ideas were, however, not very clear on this subject. They also believed that the dead would leave the grave sometimes during the night and go hunting. Owing to this belief, no doubt, all personal property was buried with them, as well as other things they might require. The name of the dead was never mentioned by them on any account, and if anyone mentioned it inadvertently they stopped their ears and asked not to be reminded of the dead. If dogs had been owned by the deceased, these were sent to some friendly tribe that their sight might not remind them of the departed. They carefully avoided the graves.*

The Omeo Blacks (as well as the neighbouring tribes) were inveterate cannibals, and at every opportunity would eat the flesh of their enemies, but especially their kidney fat. They would, however, not eat a member of their own tribe.

Their weapons consisted of clubs (*nulla nullas*), boomerangs, shields (*hielanan*), stone tomahawk (*unigong*), and three or four kinds of spears, which were made of reeds, seedstalks of the grass-tree, boxtree, or if procurable, ironbark. The reed and grasstree spears were thrown with the *wommer*, but the heavier and larger wooden spears were thrown with the hand after being well balanced by holding them near the middle. The boomerangs were different also; the larger sort was used for fighting, and a

* Mr. Barry on one occasion noticed two bandicoots near a native grave and told some blacks of it who were camping a short distance from the place. Snow was lying on the ground at the time and the natives were hard pressed for food, but they would not touch the "bandies" because they believed them to be the dogs of the dead. When Mr. Barry shifted some of the boughs that were lying over the grave, under which the animals hid themselves, to convince the natives that they were bandicoots and not dogs, they implored him to desist, adhering to it that the animals were "dog of poor fellow."

smaller sort, which was more curved than the other, they threw at birds. This if thrown against the wind would return to the thrower after making one or two circles in the air. The commonest implement was the yam stick, a plain stout cudgel about four feet long, sharpened and hardened in the fire at one end. It was used for digging out roots and other food from the ground, and in case of need served for defensive purposes.

For carrying water they made a vessel out of bark in the shape of a small canoe. For this purpose they thinned a suitable piece of bark at both ends and placed it in hot ashes to make it soft and pliable, and whilst in this state the ends were folded and tied.

Their canoes were mostly made of bark which was gathered in folds at both ends, after these had been sweated in hot ashes, and fastened together with withes and wooden pins. They chose a convenient crooked tree and stripped the bark from the bent part of it that was already naturally shaped like a canoe. To prevent leaking, a good-sized lump of clay was pressed in at both ends, and if through running on a snag or some other accident, leaks occurred, these were as a rule also stopped with clay. Such canoes did not usually last for a great length of time on account of their fragile nature and the rather rapid decay of the material, but they were more frequently used than those made of wood because they could easily be replaced if destroyed by an enemy. The wooden canoes were made out of a suitable log, and their manufacture demanded a great deal of labour. They had to be entirely worked with stone implements, assisted by lighting a fire inside, which when carefully managed would destroy the bulk of the wood to be removed. Generally they adopted a partly hollow tree for this purpose.

Besides the casual ornamentation of painting, they used to mark their body with tattoo scars. These were produced by means of some sharp stones with which the flesh was incised. To stop the blood and to form the scars they lay down on a heap of fine ashes. Ashes were also applied if at any future time the bleeding should start again. This was all that was used to raise the scars above the surface of the skin. At the age of 17 to 20 years were made

these tattoo scars which were from an inch and a half to two inches long as a rule. It took some time to make the whole series of them, as they allowed those made first to heal before they started others. In this way first the back and then the chest and arms were operated upon in rotation. The women were also tattooed on the chest and arms, but not to such an extent as the men. The marks were supposed to indicate their family descent as well as tribal connection.

Both the men and the women had the septum of the nose pierced to carry a piece of polished kangaroo bone. A woman considered herself looking her best when she had about six or eight inches of bone pushed through her nose. The reason for this habit was that, in addition to its being considered ornamental, when they returned on earth again after death, either as a swan, duck or fish, &c., they would then have a hole ready made for the purpose of breathing.

A FEW NOTES ON THE MONARO TRIBE OF ABORIGINES, WITH A
DESCRIPTION OF SOME OF THEIR STONE IMPLEMENTS.

The once numerous tribe inhabiting the Monaro District, comprising the south-western highlands and tablelands of New South Wales, is now almost extinct. The last typical specimen is incarcerated in Goulburn gaol for killing his gin a little more than two years ago, and besides him I believe only another fullblood (young and civilised) native of the tribe exists, who is at present living near Buckley's Crossing. The only one of them I ever saw was "Bonny Jack," the "King" of Monaro, whom I met five years ago. He was a short, rather broad shouldered man with an open countenance and a merry disposition. At the time of our meeting he had not long buried his gin, "Polly,"* and intended to go across the border, if I remember right, with the intention of

* From a correspondent I hear that he "interred" her in a hollow tree by the side of Spring Creek Lake, not far from Berridale. He derived some consolation, or pretended to do so, from the belief that his Polly would "jump up white lady by and by."

trying to get another from a friend who had still two left. He complained bitterly to me that "white fellow" destroyed all the "possum," a grievance, I was later informed, he was constantly harbouring and generally ventilated to new acquaintances. He died recently at Cooma, and with him it may be said the last remnant of the real old stock of manly savages belonging to this tribe disappeared, reaching a good old age and weathering the tempest of vice and demoralisation foisted upon these unhappy people by civilised whites.

I have been told a few stories of individuals who have been illtreated and even murdered by white blackguards, but these isolated instances are nothing compared to what the rum bottle and diseases have accomplished towards wrecking these tribes. Forty years ago they could muster several hundred individuals, although from time immemorial they had been in constant and bloody contentions with most of their neighbours, and to-day, after such a short span of time, owing simply to altered conditions, they have all disappeared but two.

Not far below Jindabyne, where the valley of the Snowy River somewhat narrows between rather rugged hills, used to be in olden times a favourite camping place of the natives who assembled here (even within the knowledge of some settlers) in considerable numbers, mainly for the purpose of making stone implements. A shingle bed near one of the bends in the river furnished excellent and abundant material for tomahawks amongst the flattish and more or less oval pebbles.

Many half finished tomahawks and pebbles, the shaping of which had just been commenced, have from time to time been picked up near this locality, and some may still be found there. The blacks were not likely to encumber themselves with too much weight, and therefore only the finished articles were carried away, the unfinished being left behind to be taken in hand again on the next return to the place.

Plate xxix. represents three such pieces of stone showing the commencement of the work, and one finished tomahawk. The

first three were found by me at the place described, and the last was discovered not far from it near the Crackenback River.

It seems that the first thing in shaping a tomahawk, after selecting a suitable pebble, was simply to beat another stone against it and chip the edges to a slanting face that would produce a sharp angle with one of the planes of the stone. This is all that has been done to the first three specimens represented, the rock of which is a fine grained felspathic quartzite of dark grey colour.

The finished implement is made of a similar material, but somewhat lighter in colour. It is a well finished weapon or tool with a sharp cutting edge and highly polished bevelled sides. The other part of it is dressed smooth by being beaten with another stone. By this method also the indented hollows for fingerholds on the broadest surfaces of it are evidently produced. The implement seems to have been only intended to be held with the hand when it was in use, and is in reality an adze rather than a tomahawk. It weighs twelve ounces.

A NATIVE BURIAL PLACE.

During my visit to the Monaro District in the early part of 1889, I opened a grave near Cobbin (situated between the Snowy River and its tributary the Mowamba River) that was pointed out to me by Mr. Thompson, the owner of the run. To this gentleman I owe the particulars I am about to communicate concerning the individual whose remains I undertook to disturb.

It had been an old man who for several years prior to his death was carried by the tribe from place to place when they shifted their camp, because owing to some hip disease he was unable to walk. The wailing and lamentations over his death lasted for three nights and three days, and a great many natives assembled to assist in the funeral ceremonies. A number of half decayed sticks still lying in a semicircle about twenty yards from the grave marked the place where some brushwood had been heaped up to form a shelter against the wind, and some charcoal indicated the spots where the fires had been lighted during the nights.

The grave was situated in an elevated position on a low rise consisting of coarse gritty and clayey soil. The dry situation and the natural compactness of the soil no doubt greatly helped to preserve the grave, which could be distinguished quite plainly although it was over seventeen years since it had been formed. A circular mound rose about two and a half feet from a base which was upwards of five feet in diameter, irregularly flattened out at the edges and strewn with sparsely imbedded rock fragments. In the centre of the mound there were three posts.

In removing the soil and stones I found that the grave must have been dug over six feet deep in the solid ground, and seemed to have had an oblong shape of about four feet in length by two and a half feet wide. At the bottom a dome-like excavation about three feet long and nearly two feet high had been made in one of the longest sides of the hole, into which the corpse had been pushed. The opening had been covered by bark and grass, against which flat stone slabs had been placed. The hole was filled with granite slabs carefully laid down, with grass in the interstices, for some distance, and over this with stones and earth. At each end of the grave had been placed a strong sapling that rose from the bottom by the side of the cavity in which the body rested to about four feet above the surface of the ground, and a third one was placed midway between them after a few feet had been filled in. These were the posts that rose from the mound, and which guided me to the cavity containing the corpse.

Although the death took place seventeen years before I opened the grave, I found no difficulty in determining the method in which the body had been prepared for interment. The knees had been drawn up to the abdomen and lashed with bast, the elbows had been laid close to the sides, and the hands were placed flat in front of the face. Although nothing but the bones of the man remained, their position left no doubt that the limbs were placed as described. It was evident that the body had been lashed together into the smallest possible compass by bast being coiled round it in all directions. After being tied up it had then been wrapped in a blue blanket, perished fragments of which still

remained, and then in thick fibrous bark that was well lashed round it.

The bones were still very solid, although discoloured. The skull seemed to me of a much lower type than most skulls I have seen, and by no means indicated intellectual power, which might have been expected from the way the individual had been revered by his tribe. The forehead receded very much and was strongly developed over the orbits, and the jaws were extremely powerful, forming a protruding chin that gave the whole face a receding aspect.

Both hip bones were considerably swollen towards the upper margin and showed a distinct honeycombed character which was unmistakably the result of necrosis. From the appearance of these bones it cannot be doubted that the man was unable to walk during the advanced stage of the disease, and he must have suffered a great deal of pain judging from their abnormal condition.

Note.

Unless seen it is scarcely credible what an enormous number of the Bugong moths inhabit the crevices and clefts of the rocks on the highest ridges of the mountains. The crows have become the principal exterminators since the blackfellow has disappeared, and they do their work effectively by entering the narrowest apertures. Thousand of crows may be seen swarming during the whole of the summer about the rocks feeding upon nothing else but the moths. The enormous number of these birds congregated at the highest peaks can only be appreciated by approaching them under cover, as I did in February, 1893, when on a visit to the Australian Alps, and surprising them in their secret pursuit on one of the rugged peaks. As soon as I was observed by one of them, a caw of alarm was raised, which was rapidly repeated by others, and from every crack and cranny their black plumage burst forth. Soon thousands of crows rose in the air almost like a cloud, making the environs resound again

with their mingled caws of terror and surprise. On land I have never seen such a number of birds rise together as I saw at Mt. Tate; it could only be compared to the incalculable number of sea-fowl that rise when they are disturbed at their lonely rock-isle by a sudden shot from a passing vessel.

It is almost impossible to form an estimate of the number of the insects that are annually devoured by the crows; just as difficult as it is to form an idea of the masses formerly consumed by the blacks. The figure in each case must, however, reach high into the millions. Like the dusky coloured men, the birds are fonder of this food than anything else, and will not touch even dead or dying sheep, I am informed, whilst plenty of "Bugongs" are to be found. My own observations confirm this statement.

The Dingo, as well as the Native Cat, it is stated, feed upon the moths.

Dr. R. von Lendenfeld (Report on the Gold Fields of Victoria, 1886, p. 72), speaking of the Bogong Range, states:—"The high tablelands which constitute the nucleus of this range are inhabited by a species of moth belonging to the *Noctuina*. The caterpillars of it are exceedingly abundant, and formed, half-roasted, at certain seasons, a favourite food of the Australian natives. The natives call these caterpillars 'Bogong,' which name was afterwards applied to the habitat of the Bogong," &c.

The statement as to the caterpillars having been eaten is incorrect. The larvæ of *Agrotis spina*, Gn., like the imago, are shy of light. They are night feeders, and hide during the day, like all other species of the genus, in the ground or at the base of plants, and besides are protected by their colour. Their habits, as well as their protective colour, prohibits a collection in numbers sufficient to serve as food for whole tribes of natives.

The accompanying sketches I owe to the skill of my young friend, Mr. Claude Fuller, whose valuable assistance was readily given and is deserving of my warmest thanks.

EXPLANATION OF PLATES.

PLATE XXIX.

Figs. 1-3.—Flat stones chipped at the margins, showing the first preparation for the production of a sharp edge.

Fig. 4.—Finished tomahawk, or adze; the asterisks indicate the position of the circular depressions or fingerholds ($\frac{2}{3}$ nat. size).

PLATE XXX.

Grave of an Aboriginal; with sections of the same, showing the body as placed in the cavity, and the manner in which the hole was filled.

NOTES AND EXHIBITS.

The newspapers of 1st inst. reported that at Wilcannia nearly an entire flock of sheep had been poisoned through eating ravenously of "grey bush," resulting in the deaths of 3700. Mr. Fred. Turner exhibited a specimen of the plant implicated, which turns out to be *Kochia pyramidata*, Benth. As this is not a poisonous plant, the fatal results were more reasonably attributable to mechanical irritation and inflammation arising from eating too voraciously of the indigestible twiggy branches. A photograph of the defunct sheep as they lay in camp was also shown, and extracts were read from a letter from Mr. A. J. Esau, of the "Western Grazier," which confirmed the diagnosis given above, and added that the sheep were in very low condition, almost at starvation point, and that when the opportunity came they simply gorged themselves with "grey bush."

Mr. Maiden and Mr. Baker exhibited specimens to illustrate their papers.

Mr. Maiden also exhibited specimens of a very young cocoanut plant, showing the early growth of leaves and roots, from Aneityum, New Hebrides. Also, from the same island, a native drill consisting of small quartz crystals fastened to a round stick about 2 ft. long. A piece of perforated rock and loose crystals also accompanied the exhibit.

Mr. Hedley exhibited a valve of *Cardium flavum*, Linn., from Port Jackson.

Mr. Masters exhibited a collection of 170 species of named Coleoptera, lately received from Mr. Arthur M. Lea, of Western Australia, containing types of all the species described by him in his last paper. The following families were represented:—*Malacodermidae* 59 species, *Pythidae* 3, *Pedilidae* 5, *Pyrochroidae* 2, *Mycetophagidae* 4, *Curculionidae* 3, *Melandryidae* 6, *Mordellidae* 47, *Anthicidae* 15, *Corylophidae* 20, and a few others.

Professor David exhibited (1) a number of transparent rock sections, prepared by Mr. Brook, of Sydney University, of an oolitic limestone from the Manning River, New South Wales.

The limestone contains numerous foraminifera, and abundant remains of small organisms, the precise nature of which has not yet been determined. The specimen from which the sections were cut was presented by Mr. C. W. Darley, M. Inst. C.E. The rock is probably of Carboniferous age. (2) A specimen of fossil algæ (?), collected by Mr. C. Jenkins, from the Yass District, and now in the Geological Collection at the University of Sydney.

Mr. Mitchell, Narellan, exhibited some fossils from the Wianamatta Series, in the neighbourhood of Narellan, consisting of insect remains and impressions of a plant apparently belonging to the *Teniopteride*. Mr. Froggatt, of the Technological Museum, had determined the insect remains to be referable to the Families *Blattide* and *Buprestide*. Of the former there were impressions of fragments of wings, and of the latter of an elytron. Mr. Etheridge, Curator of the Australian Museum, to whom the specimens had been submitted, confirmed Mr. Froggatt's opinion. The plants consisted of fragments of leaves showing rows of papillæ along each side, or in some cases along one side, of the midrib on the basal portion, which may be sori. The fossil Orthoptera are from a railway cutting on the Great Southern line at Glenlee; the Buprestid and plants from the Great Road about a mile N.E. of Narellan. Mr. Mitchell also exhibited some oolitic limestone found in a sample of lime from Marulan.

WEDNESDAY, JULY 31st, 1891.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, July 31st, 1895.

The President, Mr. Henry Deane, M.A., M.I.C.E., in the Chair.

Dr. James Froude Flashman, B.Sc., Hospital for the Insane, Parramatta, was elected a Member of the Society.

The President said that he had to announce with regret the death, on the 9th inst., of a member, Dr. P. H. MacGillivray, M.A., of Sandhurst, Victoria, well known for his important series of contributions to a knowledge of Australian Polyzoa, covering a period of more than thirty-five years.

DONATIONS.

Geological Survey of India—Records. Vol. xxviii. Part 2 (1895). *From the Director.*

Perak Government Gazette. Vol. viii. (1895), Nos. 12-17. *From the Government Secretary.*

New Zealand Institute—Transactions and Proceedings, 1894. Vol. xxvii. *From the Institute.*

Pharmaceutical Journal of Australasia. Vol. viii. (1895), Nos. 6-7. *From the Editor.*

Zoologischer Anzeiger. xviii. Jahrg. Nos. 475-477 (May-June, 1895). *From the Editor.*

University of Melbourne—Calendars for the Years 1894 and 1895. *From the University.*

Boston Society of Natural History—Proceedings. Vol. xxvi, Parts 2-3 (1893-94): Memoirs. Vol. iii. No. xiv. (1894). *From the Society.*

New York Academy of Sciences—Transactions. Vol. xiii. (1893-94). *From the Academy.*

California Academy of Sciences—Proceedings. 2nd Ser. Vol. iv. Part 1 (1894). *From the Academy.*

American Academy of Arts and Sciences—Proceedings. Vol. xxix. (1893-94). *From the Academy.*

Cincinnati Society of Natural History—Journal. Vol. xvii. Nos. 2-3 (1894). *From the Society.*

American Philosophical Society—Proceedings. Vol. xxxiii. No. 145 (1894). *From the Society.*

Academy of Natural Sciences of Philadelphia—Proceedings, 1894, Part ii. *From the Academy.*

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Smithsonian Institution, Washington—Annual Reports of the Board of Regents for the years ending July, 1892, and July, 1893. *From the Institution.*

Bureau of American Ethnology—Tenth Annual Report, 1888-89: Bibliography of the Wakashan Languages. By J. C. Pilling: The Maya Year. By C. Thomas: Pamunkey Indians of Virginia. By J. G. Pollard. *From the Director.*

U.S. Department of Agriculture—Report of the Secretary, 1893: Division of Entomology—Insect Life. Vol. vi. No. 5; Vol. vii. Nos. 1-3 (1894): Bulletin. No. 32 (1894). *From the Secretary of Agriculture.*

Gesellschaft für Erdkunde zu Berlin—Verhandlungen. Vol. xxi. (1894), Nos. 7-9: Zeitschrift. Vol. xxix. (1894), Nos. 3-5. *From the Society.*

Naturhistorisches Museum in Hamburg—Mitteilungen. xi. Jahrg. (1893). *From the Museum.*

K.K. Naturhistorisches Hof-Museum, in Wien—Annalen. Bd. viii. Nos. 1-2 (1894): Bd. ix. Nos. 1-2 (1894). *From the Museum.*

Köngl. Böhmisches Gesellschaft der Wissenschaften—Sitzungsberichte, 1892-1893: Jahresbericht für die Jahre 1892-93. *From the Society.*

K.K. Zoologisch botanische Gesellschaft in Wien—Verhandlungen. xlv. Bd. 1-2 Quartal (1894): xlv. Bd. 4 Heft (1895). *From the Society.*

Verein für Vaterländische Naturkunde in Württemberg—Jahreshefte. L. Jahrgang (1894). *From the Society.*

Naturforschender Verein in Brünn—Verhandlungen. xxxi. Bd. (1892): xi. Bericht (1893). *From the Society.*

Académie Impériale des Sciences de St. Pétersbourg—Bulletin. Nouvelle Série. T. iv. (xxxvi.), Nos. 1-2 (1893-94): Mémoires. T. xxxix. Seconde Partie (1893); T. xli. Nos. 8-9 (1893); T. xlii. Nos. 2 and 11 (1894). *From the Academy*

Victorian Naturalist. Vol. xii. No. 3 (June, 1895). *From the Field Naturalists' Club of Victoria.*

Medicinisch-Naturwissenschaftliche Gesellschaft zu Jena—Jenaische Zeitschrift. xxix. Bd. 3-4 Heft (1895). *From the Society.*

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Natural Science Association of Staten Island—Proceedings. Vol. iv. No. 15 (March, 1895). *From the Association.*

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Société Royale de Géographie d'Anvers—Bulletin. T. xix. 5^{me} Fasc. (1894-95). *From the Society.*

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Australasian Journal of Pharmacy. Vol. x. No. 115 (July, 1895). *From the Editor.*

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AUSTRALIAN *TERMITIDÆ*.

PART I.

BY WALTER W. FROGGATT.

INTRODUCTION.

These notes on white ants were first undertaken with the intention of working out the economic aspect of their life-history, more especially their partiality for certain timbers more than others, and the best methods of exterminating them.

There is no family of insects in the warmer and tropical portions of the earth's surface whose members wage such ceaseless warfare against man's handiwork. From their countless numbers, subterranean habits, and insidious manner of attack, none are more difficult to cope with; for often it is not until the damage is complete that their presence is even suspected. In Australia alone thousands of pounds worth of property is annually destroyed by these voracious pests. Having started on this subject, I found both material and notes accumulate so rapidly that I determined (without losing sight of the earlier phase of the question) to expand my notes into a more pretentious work, namely, the study of the habits and life-histories of all the Australian species obtainable, recording my observations when possible from living specimens.

With this end in view, I obtained the sanction of the Curator of the Technological Museum (Mr. J. H. Maiden), who has also greatly assisted me in many ways at this work, to print and issue a circular from the Museum, asking for specimens and giving brief instructions to residents of termite-infested country how to collect them.

It is from the generous way in which my valued correspondents, many of them personally unknown to me (specimens and notes

upon their habits having come to me from all quarters), that I am enabled to enlarge my observations and add much to our general knowledge of their distribution and habits.

I have also had the advantage, in earlier years, of travelling over a considerable portion of the interior of Australia, and afterwards round the whole coast, and therefore start with a personal knowledge of these pests in many phases of camp life, and a fair idea of their distribution over this great island.

PART I.—DISTRIBUTION.

In going into the literature on "white ants," I have consulted a great number of works of voyages and travels, as well as the scientific papers available; and during these investigations I have been much struck with certain interesting facts relating to the geographical distribution of termites. Therefore, before dealing with the Australian species, I propose to glance at those from other parts of the world.

In the fossil fauna of the Old World termites are very well represented; evidently in bygone epochs, as now, at certain seasons of the year the winged forms swarmed in myriads out of the nests. Fluttering about in their generally aimless manner, many of them alighted upon the soft resin coating the trunks of the pine trees, and became entombed. It is a noticeable fact that nearly all the fossil species have been described from winged forms, no soldiers or workers of most of them being met with. The resin changed to amber has retained the remnants of the prehistoric insect world, and it is to its preservative powers that we owe most of our knowledge of the fossil termites, though others have been described from other formations both from Europe and America.

In 1848 Professor Heer published his "*Ueber fossile Ameisen*"* describing the fossil insects from the Tertiary beds of Oeningen and Radoboj. This, the first systematical study of the fossil

* Afterwards translated and published in the *Quart. Journ. Geol. Soc.* London, vi. 1850.

insect world, was followed in 1852 by Dr. Hagen's* work dealing with the fossil termites of the same locality; after describing the different species he states that the climate of Europe must have been much warmer in the Tertiary age than at present to have supported such an extensive insect world, and that out of sixty known species of termites nearly a third of them were fossil. During the years 1855-60 Dr. Hagen† brought out his Monograph, in which he worked out all the then known species, both fossil and recent, among others a fossil species (*Termes grandævus*) from England, the exact locality not being given. This work still retains its place as the text book on matters relating to the classification of the *Termitidæ*.

In 1861 three species were noticed by Hagen in some Sicilian amber obtained by Hope for the Oxford Museum.‡

In 1878 Sterzel described another for which he formed the new genus *Mixotermes*, from the carboniferous of Lugau.§

In 1883 Scudder|| published an account of his studies of the fossil termites of the Florissant Tertiaries of Colorado; in this interesting paper he gives a general account of all the fossil termites known from other places, and describes six new species, forming the genus *Parotermes*, to contain the first three, while of the others one comes in the genus *Hodotermes* and two in *Eutermes*.

Brongniart¶ has made a magnificent addition to our knowledge of fossil termites in his Monograph upon the study of fossil insects, published last year.

* Ueber die Lebensweise der Termiten und ihre Verbreitung. Königsb. Naturwiss. Unterhalt., ii. 3, 53-75.

† Monographie der Termiten. Linnæa Entomol. x. (1855), pp. 1 and 270; xii. (1858), 1.; xiv. (1860), 73.

‡ Hagen, H.A. Entom. Weekly Intell. 10, 151, 168, London, 1861.

§ Sterzel, on Fossil Termites. Ber. Ges. Chemn. 1878-80.

|| Scudder, S. H. The Fossil White Ants of Colorado. Proc. Amer. Acad. Arts and Sciences, 1883, pp. 133-145.

¶ Brongniart, C. Recherche pour servir à l'Histoire des Insectes Fossiles des Temps Primaires, &c. Bull. Soc. d'Indus. Minérale. 1893, vii. (3), p. 127.

At the present time three species of termites are found in Europe, and though they are chiefly distributed along the coast of the Mediterranean and the warmer portions of Southern Europe, one species has been recorded from as far north as Odessa, Russia, where it is said to have done a considerable amount of damage. Of the three species now acclimatised in Southern Europe, only one is said to be indigenous, *Termes lucifugus*, which was known to exist in France at a very early date, though it was not until 1853 that it was reported to have committed any noticeable depredations.* Early in this year they appeared everywhere as a regular plague in the city of Rochelle, and not content with eating up the wood, found their way into the city archives and destroyed many of the State documents.

This species now ranges over the whole of the southern provinces of France, through the Spanish Peninsula, Italy, Sicily, Sardinia, the Morea, Turkey, Cypress, Egypt and Madeira.

A good deal has been written about this species, the latest being Professor Grassi and Dr. Sandias' splendid Monograph on the termites of Catania,† containing an exhaustive account of this species.

The second species, *T. flavicollis*, Fab., was originally a North African termite found at Barbary and Algiers, from whence it has made its way along the European side of the Mediterranean, being found in most of the localities infested by the previous species.

The third, *T. flavipes*, is the common North American species, which has been introduced into Europe, probably in the first instance with logs of timber, and has been discovered as far east as the Bath House of Schoenbrunn at Vienna.

Many instances have been recorded of small colonies of termites having been introduced into botanical gardens and hot

* A. de Quatrefages. Notes on the Termites of Rochelle. Ann. Sci. Nat. (3^e sér.) Zool. xx. 1853. pp. 16-21.

† Prof. B. Grassi and Dr. A. Sandias. Atti dell' Accademia Gioenia di Sc. Nat. in Catania. Ser. 4, Vol. vi. 1894.

houses in specimens of foreign timbers; in 1874 such a family was discovered in the palm house at the Royal Gardens at Kew, where they were isolated and kept under observation for some time, specimens being exhibited by Mr. R. McLachlan* at a meeting of the Entomological Society of London in 1874.

Turning to Africa, we find that termites are very generally distributed, about twenty species having been catalogued in Hagen's list from this part of the world; of these two are peculiar to the Isle of France, and one to Madeira; some species are very local and confined to small areas, while others have a very wide geographical distribution. The famous *Termes bellicosus*, immortalised by Smeathman† in the earliest and most complete account of mound-building termites, according to Hagen, ranges round the whole coast line of Africa.

As might be expected, the nearer to the equator the more plentiful the termites; and nearly all equatorial travellers have something to say about these pests. Paul Du Chaillu‡ gives a general account of several species on the west coast in his popular works of travel; Oates§ notices those in Matabele Land, and figures one of their larger nests; while Professor Drummond|| deals extensively with those found in the Lake Nyassa country. Though termites are so plentiful on the main land, I can find no species recorded from Madagascar.

The hold that the white ants have obtained on that rock-bound island, St. Helena, is a remarkable instance of accidental colonization. It is stated on good authority that before the year 1840 white ants were unknown on this island; but at this date a captured slaver was condemned and dismantled at Jamestown, in

* R. McLachlan. Proc. Ent. Soc. p. xiii. 1874.

† H. Smeathman. On the Termites of Africa and other hot climates. Phil. Trans. Royal Soc. London (Abridged Edition), Vol. xv. p. 61, 1781.

‡ P. du Chaillu. Explorations and Adventures in Equatorial Africa, p. 314, 1868; and My Apingi Kingdom, pp 115-142, 1871.

§ Frank Oates. Matabele Land and the Victoria Falls. London, 1881, p. 134.

|| H. Drummond. Tropical Africa, chap. vi. London, 1889.

the timbers of which there was introduced a South American species (*Eutermes tenuis*, Hagen) common in Brazil. So destructive did they become that several Royal Commissions were appointed to consider the best methods of dealing with them. Melliss* states that they have destroyed over £60,000 worth of property in this island.

Passing into Asia, none are recorded from the northern and central countries. Crichton† says that in some parts of Arabia they are very destructive to young trees, which the Arabs protect by coating the trunks with sheep dung. Two species are catalogued by Hagen from Schiraz, on the Persian Gulf, beyond which until we reach India is a blank. In the latter country, particularly in the southern provinces, white ants are numerous and destructive, though there are apparently not a great number of species among them. *Termes taprobanes*, one of the commonest, is very plentiful in Ceylon, also extending into Borneo, Sumatra and Java, all of those islands having several other species recorded from them.

In the Philippine Islands they are well known. Seoane‡ gives an interesting account of a Spanish man-of-war which was completely destroyed by *Termes dives* while lying in the Port of Ferrol.

Döderlein§ has described a species from Japan. Mr. Knowler, of the Johns Hopkins University, U.S.A., a well-known worker on the Termites, tells me that the common American species, *Termes flavipes*, is recorded from Japan, but I presume it has been introduced into the latter country.

Peel|| has given an account of those from Assam, and Romanis¶ observed them and noted the habits of a species (probably *Termes*

* Melliss, J. C. St. Helena. pp. 171-176, 1875.

† A. Crichton. History of Arabia, Ancient and Modern. Edinb., 1883, p. 461.

‡ V. L. Seoane. C.R. Ent. Belg. xx. pp. xiv.-xv. 1879.

§ L. Döderlein. Mitth. Ges. Ostasiens, iii. pp. 211-212. 1881.

|| S. E. Peel. Nature, xxvi., p. 343, 1882.

¶ R. Romanis. Entomologist, xvi. pp. 214-215.

tapprobanes) in Rangoon. In the Zoology of the Novara Expedition, Brauer has described two species from the Nicobar Islands; while Forbes* noticed them on the Cocos Keeling Islands, where he says they were introduced some years before; this is the only instance in which I have been able to find them recorded from a coral island.

Extending down into the Australian region, there is no record of any species from the mainland of New Guinea, though I have made special enquiries. D'Albortis† mentions them twice on Yule Island, no great distance from the mainland, and it is most likely that they occur inland; for at the present time most of the known portions of New Guinea are either river delta country or mountain ranges, neither of which is suitable for their habitations.

Three species are known from New Zealand, four from Tasmania, and six from Australia.

I have been unable to come across any reference to Termites being found in any of the Pacific Islands, but within this last month I have received some from the New Hebrides. They belong to a very large species and were sent from Aneityum in a bottle full of insects by the Rev. J. H. Lawrie to the Technological Museum. In the Hawaiian Islands Blackburn‡ found two species very plentiful, both of which are American forms and may possibly have been introduced.

The home of the white ant, however, appears to be South America, and its headquarters Brazil; from which country alone twenty-seven species are known. Many of these were collected by Bates§ on the Amazons, who recorded the habits of several species; while Fritz Müller|| has contributed largely to our

* H. G. Forbes. *A Naturalist's Wanderings in the Eastern Archipelago*. London, 1885.

† D'Albortis. *New Guinea*, Vol. i. pp. 355-401. 1881.

‡ R. McLachlan. On the Termites collected by the Rev. Thos. Blackburn. *Ann. Nat. Hist.* (5), xii. p. 221, 1883.

§ H. W. Bates. *Naturalist on the River Amazon*, Lond. 1863; and *Proc. Linn. Soc.* Vol. ii. 1854.

|| Fritz Müller. *Beiträge zur Kenntniss der Termiten*. *Jen. Z. Nat.* vii. pp. 337, 451, 1873; and *l.c.* 1875 and 1887.

knowledge of these insects in working out the life-histories of those found in the vicinity of Santa Catherina. White ants have been described from Banda Oriental and the Argentine Republic on the east to Chili on the west.

All the West Indian Islands are more or less infested with them. Cuba has several species. Hubbard* has described the habits of those found in Jamaica, of which the tree nest building *Eutermes rippertii* is the most plentiful; Maynard† has noted them on the Bahamas, and Moseley‡ on the Virgin Islands, while Hagen has catalogued them from St. Domingo and St. Thomas, and Marshall§ has studied the habits of *Eutermes destructor* in Antigua.

Central America is very thickly infested with them, and during the construction of the Panama railway line they did an immense amount of damage to the rolling stock and wood work of the houses. Two officers of the company, Messrs. Dudley and Beaumont,|| kept a number in captivity and discovered some interesting habits of the commonest species.

The common species in North America is *Termes flavipes*, which is distributed nearly all over the United States, with several others more local in their habits. Scudder¶ has recounted their ravages in Florida. Buckley** has described two species from

* H. G. Hubbard. Notes on the Tree Nests of Termites in Jamaica. Proc. Bost. Soc. xix. pp. 267-275, 1878.

† Maynard. Notes on the White Ants in the Bahamas. Psyche, v. pp. 111-113, 1888.

‡ H. N. Moseley. Notes by a Naturalist on H.M.S. Challenger, p. 12, New Edit. 1894.

§ T. A. Marshall. On the Habits of some species of Termites in Antigua. Proc. Ent. Soc. p. xxxiv. 1878.

|| P. H. Dudley and J. Beaumont. Observations on the Termites or White Ants of the Isthmus of Panama. Trans. New York Acad. of Science, Vol. viii. 1889.

¶ S. H. Scudder. Ravages of White Ants in Florida. Canadian Entomologist, xix. p. 217, 1887.

** S. B. Buckley. Descriptions of two new species of Termites from Texas. Philad. Entom. Soc. Proc. 1861-63, pp. 212-215.

Texas; they are known in Mexico; and Osten-Sacken* has studied the habits of those in California. In the Southern States along the Mississippi they do a great deal of damage at times, while in 1879 Hagen† reported that they appeared in great numbers at Cambridge, Mass., but disappeared the following season. The most northern limit of the white ant is Manitoba, whence one species (*Termopsis occidentalis*) has been recorded by Treherne.‡

To give an accurate account of their geographical distribution in Australia is no easy matter, as much of the country has been very cursorily examined as regards its insect fauna; and few of the naturalists on overland expeditions have collected white ants unless they were very much in evidence. However, all along the eastern coast line, which is mainly forest country, termites are plentiful; in southern Gippsland they are a well-known pest, and more northward in the Goulburn Valley (Victoria) we have several accounts of their attacks upon vines and fruit trees. In the northern parts of Victoria several species are found, but never in great numbers, and seldom forming distinctive nests. Coming into New South Wales, in the Shoalhaven district there are two common species constructing nests, many of the larger nests being from six to seven feet in height. These tall nests are dotted all over the flats, but are seldom met with on the higher hills; they are formed by our common yellow-headed termite, which though common in the neighbourhood of Sydney does not make any kind of nest, but lives under logs and stones or in old timber. North of Sydney, towards Newcastle, white ants are common among the dead timber, the arboreal *Entermes* building their nests up the trees being the prevailing species. A resident of Cape Hawke informs me that they are very bad in that neighbourhood. I have several species from Uralla where there are plenty of the yellow-

* G. R. Osten-Sacken. Observations on Termites found in California. Proc. Boston. Soc. xix. p. 72, 1877.

† A. H. Hagen. Notes on a Great Cloud of Termites appearing in 1878. Proc. Bost. Soc. N. H. xx. p. 118, 1879.

‡ H. S. Treherne. Notes on species observed in Manitoba. Proc. Bost. Soc. N. H. xix. p. 74, 1877.

headed termites' tall nests; they are generally scattered over the northern districts of New South Wales and southern Queensland. North of Rockhampton they begin to be noticeable as a pest, though the large nests are not very common; from Mackay I have at least five species; towards Townsville they increase in numbers, and about Charters Towers and northward are a very serious trouble. It is only here and there, however, that the large mound nests appear; but the arboreal nesting *Eutermes*, though not always building on the trees, seem to be found all over the country. From Cooktown and all over Cape York the nests are large and numerous; the magnetic nest so well-known in Port Darwin being found on the Bloomfield River, north of Cooktown.*

At Somerset (Cape York), there is one of the most remarkable termite cities in the world; viewed from the sea, and looking up beyond the old Government Residency, now occupied by Mr. Frank Jardine's homestead, it appears as if the plain for a mile or more in extent is covered with pointed pillars six or seven feet in height, broad at the base and tapering to the summit, forming regular symmetrical pyramids. They are thickly dotted over the plain, often only a few yards apart; the effect is much heightened if the grass has been freshly burnt off, as it had been the first time I passed Somerset.

Several writers have noticed this city of the termites. Moseley† likens them to kiln chimneys; he says that it gives the country the appearance of a pottery district in miniature, and states that many of them are ten feet high. D'Albertis,‡ writing of this place, says:—"Termite nests, both on the hills and plains, measured often ten feet in height and thirteen feet in circumference at the base"; he found upon opening them that many were attacked and often almost exterminated by large black ants.

* D. Le Soeuf. A visit to the Bloomfield River. *Victorian Naturalist*, Vol xxi. 1894, p. 25.

† H. N. Moseley, l.c. p. 302.

‡ D'Albertis, l.c. p. 229, Vol. i.

On Thursday Island and the many islands round Cape York, the same form of nest is met with; turning down into the Gulf country and to the watershed of the Flinders River and its tributaries, we find one of the most termite-infested localities in the world. Nothing is too hard or dry for them; stockyards, fences and houses only last for a few years in spite of all precautions; a branch is attacked as soon as it is dead, and in many places no stumps or dry wood is left in the scrubby forests; everything is swept up as it were by these underground gnomes, who as forest scavengers do their duty thoroughly. If one cuts some grass for a bed and leaves it lying upon the ground for 24 hours, anywhere on the lower Flinders, one will find it cut up into fine chaff by the termites which have come up from the earth beneath, and if one is inexperienced enough to leave his blankets on the top of it, he will find all the lower folds riddled with holes. Earth scoops and carts that had been left in the paddocks for a while at Cambridge Downs Station were brought in with the felloes of the wheels (hard seasoned timber) gnawed to a shell, while things in the store had to be constantly turned over, as they even carried their clay up into the cases of soap, jams and meats, which not only destroyed the boxes but caused holes to rust in the tins and spoil their contents. At a hut on this station where I used to camp, the sides were built of upright saplings about six inches in diameter; the termites had worked their way up these, reducing each to a simple pipe of bark. In the silence of the night I have often lain awake listening to the sound of the millions of tiny jaws gnawing at these timbers, voices of the night as strange and uncanny as one could well imagine.

Passing from Normanton towards Port Darwin, we are still in thickly infested country, and about ten miles out from Palmerston are some of the tallest termite nests in the world. I am indebted to Mr. N. Holze, the Curator of the Botanic Gardens there, for photographs and specimens from these and the magnetic nests, which will be dealt with in detail later on, together with the species that form them.

In that portion of North-western Australia stretching across from Cambridge Gulf to Roebuck Bay, known as the Kimberley

district (where I spent over twelve months), and probably as far as the De Grey River, all through the open forest flats and along the edge of the sandy "Pindan" country are found numbers of large broad nests, from five to six feet in height, rather constricted at the base, but swelling out on the sides in rounded masses, where additions have been made, while the summit is broad and rounded, giving them somewhat of a mushroom-like appearance.

As there are few or no trees over a belt of country to the westward of the De Grey River for over three hundred miles, the termites apparently disappear, nor can I find that they construct nests or are at all noticeable in any other part of Western Australia, but they have recently been reported as having attacked the telegraph poles between York and Coolgardie. This also applies to South Australia, though it must be remembered that scattered bands of termites may be found in almost any part of Australia which may attack an odd plank or tree, but they are not in evidence as a serious pest.

In the vast tracts of dry and sparsely timbered country in central Australia, termites are naturally scarce, and probably wanting altogether in many parts of it. I never remember seeing a mound nest west of the Darling or even in the northern districts of Riverina, but with further observations from my many correspondents, I hope to enlarge our knowledge of their distribution and supplement this necessarily rough sketch.

TERMITARIA AND THEIR STRUCTURE.

Broadly speaking, termites' nests may be separated into three different typical forms, each of which undergoes several important modifications in outward appearance, but always has the same internal structure. The first may be called the turret or regular mound nests, varying from eighteen feet in height to a little pinnacle only a few inches above the surface, and sometimes simply a bald patch upon the ground. In these abnormally high ones the clay is generally carried up the face of a dead tree, which is gradually sheathed with this coating, while the trunk beneath is changed into triturated wood which in time becomes converted

into a hard papier-maché-like substance. The foundations of the smaller mound nests are commenced at the base of a stump or thrown up from under a fallen log. A correspondent in Kimberley, W.A. (W. O. Manbridge), tells me that a species there forms its nest over the spinifex bushes. I have examined a great number, all of which give proof of this, and they can be found in all stages of growth. Though later writers have doubted the fact, Hooker* as early as 1855 wrote that the Indian species always commenced their nests over decaying woody or vegetable matter.

That the different species have peculiar ways of their own when forming their mounds must be allowed, but the internal architecture of all of them is based upon one uniform plan, and as an illustration of this I will describe the commonest large earth covered nest found in New South Wales.

During a visit to the Shoalhaven district towards the end of last year I had ample opportunities of examining a number of these large nests, which are scattered thickly over all the open forest country along the river, but are seldom found towards the top of the ranges, the nests of the smaller *Eutermes* taking their place. Roughly speaking, the average is about one nest varying from three to seven feet in height to every four acres. They vary a little in outward shape, but a well-designed nest about six feet in diameter at the base will run up nearly the same height, with a slight slope on the sides to the apex, which is dome-shaped, not more than three feet in diameter. The enveloping walls consist of the surface soil only (a pale yellow sandy-brown) very hard on the weatherworn surface, but much softer when cut into. The basal portion of the walls are very much thinner than the dome-shaped summit, the lower portion of the wall often not being more than a foot in thickness, while the summit has a two-foot wall over it. All this earth is gathered from the surface by the termites and not mined from below, as many popular writers have asserted. In this locality this is plainly demonstrated, for three inches below the surface

* J. D. Hooker. *Himalyan Journals*, London, 1855, Vol. i. p. 18.

there is nothing but coarse gravel of which the large nests of the common reddish-brown ant (*Iridomyrmex purpureus*), also common in this district, and which construct large underground chambers, are wholly composed.

The foundation of the termite nest rests upon the surface and is complete in itself, and if you cut one round the base and then insert a lever under the edge it is very easy to overturn the whole nest; underneath the ground is smooth and hard with only a few insignificant passages leading below.

Under normal conditions the enveloping earthy walls contain very few insects, though there are always a few winding passages running upwards and traversing them at irregular intervals; upon the removal of this outer wall you expose a pyriform mass of roughly granulated woody substance in contact with the covering wall at the base, but gradually receding from it toward the apex, where a space of several inches divides them. The summit of the mass on the outside can be easily broken off in lumps, but as you cut into it it becomes harder and more solid; galleries run all round these masses and form irregular mazes of roadways lower down, giving the termites access to all parts of the structure. This portion of the nest (all the inner portion enclosed in the earthy dome) is organic and is chiefly composed of triturated wood which has at one time been gnawed up by the termites and then evacuated by them; each of these granulated lumps shows a distinctly foliated structure as if it had been formed in thin coats; no doubt when the fresh wood supplies are used up, this part of the nest is again eaten.

Immediately in the centre of the nest, about six inches above the base, is a rounded mass about as big as a man's head, formed of very thin layers of woody matter like brown paper, full of fine chambers and passages, the layers very close together and folding round each other towards the centre. This is the "nursery" of the termitarium, and generally contains thousands or rather millions of delicate white larvæ, many of them no larger than a pin's head. I have never seen any signs of fungi growing in these nurseries as mentioned by many writers, but the walls have a curious mottled

appearance and are full of very fine perforations; and the centre of this structure, which is very brittle and crisp, has a distinctly higher temperature than the outside.

On either side of this nursery where the ordinary galleries lead out of the finer central cells, the eggs are found piled up in little heaps like little grains of sand, white and rather elongated; perhaps as much as a big tablespoonful being found on one patch, and there may be several heaps close together. The formation now becomes slightly terraced just beyond the eggs still on a level with the nursery, and after breaking through a number of very stout terraced chambers we came upon that containing the queen; the floor of the chamber is perfectly flat and smooth, with the roof forming a low dome over her, about six inches in circumference, not unlike the cavity under an inverted saucer or watch glass. Though in many popular descriptions of termitaria it is invariably stated that there is a male with the gravid queen, I have never found one in a fully developed nest, though frequently finding a pair under stones or logs where they are evidently just commencing to found a community. Sometimes they were so much alike that it would be impossible to say which was king or queen, but in others found in similar situations the body of the queen was beginning to show the enlargement of the pregnant or gravid state and the difference of the sexes was discernible. As Fritz Müller* has shown, in the first stages of the winged adults when the insects are leaving the nest the sexual organs of the males and the ovaries of the females are very rudimentary, and it is not until the act of copulation that they become perfected.

On the evening of the 5th of October, while opening out nests on the Shoalhaven flats, I came upon a large nest scarred with narrow cuts, which upon examination proved to be slit-like openings about a line or more in height and an inch or less in length. These were all over the outside of the termitarium, and in each slit, with their heads level with the surface of the termitarium, but not showing beyond, was a regular row of soldier

* Fritz Müller. Beiträge zur Kenntniss der Termiten. Jen. Z. Nat. vii. pp. 337-451, 1873.

termites guarding the openings and not letting anything come out. Upon cutting down the walls these openings were found to run into low but broad roadways extending right through into the heart of the nest thronged with winged termites waiting until the withdrawal of the guards at the gateways. As soon as a breach was made in the walls they commenced to swarm out from all parts of the nest, and we were soon enveloped in a cloud of black winged termites buzzing about and dropping all round, causing quite a distinct noise, audible at a distance of several feet, an immense number falling to the ground. These winged specimens were found in chambers and passages all over the nest. Previously in the vicinity of Sydney I had noticed larvæ with rudimentary wings in the early part of the year, but in their earlier stages the wings grow very slowly until after the winter months are over. Termites were noticed flying about near Sydney on the 2nd and 3rd of November in great numbers.

As to the age of these large termitaria, it could only be positively ascertained by the extended observations of a resident in termite infested country. But out of a great number I have opened out I have only found one deserted, and it was only on cutting a portion of it down that I discovered this fact, for to all outward appearance it did not differ from the inhabited nests.

Smeathman and Savage, writing on the celebrated *Termes bellicosus*, state that the fullgrown queen lives for five years, the former being responsible for the statement that she lays 60 eggs a minute and never stops (presumably during the five years). Though he produces no evidence for this statement, it has been copied into nearly all the popular works and text books on entomology up to the present date, even appearing in Kirby's Text Book, published in 1885. As the working community of the termitarium have a fresh supply of females to come forth every season, and also very often a number of supplementary queens in the nest (I have obtained 10 specimens of these queens from one nest, which are I believe perfectly distinct from the ordinary winged queens, as they are not recruited from the winged forms but produced directly from the egg); it is therefore pretty

evident that the fate of the community does not hang upon the prolongation of the gravid queen, as it is not at all a difficult matter to replace her with a young and vigorous successor when necessary.

From my own observations I do not think that the queen of any Australian species either lays eggs so rapidly or lives so long. I have on several occasions unearthed a queen in a very sickly looking condition, with her abdomen yellow and wrinkled, and with her antennæ and most of the tarsi broken off, though the nest from which she was taken was swarming with life and apparently in the height of prosperity.

I should not be surprised to find that many of the larger mound nests last for a great number of years, and that white ants may also exist in their nests long after they have destroyed all the woody matter they contain, for in the tropical parts of Australia before the wet season sets in (about the middle of December) they stored food supplies. When examining some of the large rounded termite mounds near King's Sound (N.W. Australia) I found on cutting into them that all the outer galleries were full of bits of grass cut up like fine chaff, which ran out in little streams to the ground as soon as the passages were opened.

Professor Drummond* in his account of African termites previously quoted, notices the immense amount of clay carried up the trunks of trees by these insects, which, he suggests, when it is swept down by the tropical rains and is scattered over the surrounding land is a great agent towards fertilizing the soil, and that termites probably take the place of the earthworms of more temperate regions. This statement requires confirmation, for in the first instance the soil used by the termites is gathered from the surface of the ground, and whenever a large mound has been destroyed in this country I have always noticed that nothing grew upon or near it for a long time, but it had a dry, barren appearance as if the clay had been burnt.

* Drummond. Tropical Africa, l.c.

The remarkable fineness of the earth collected by the termites for their nests is put to a practical use by the natives of Ceylon,* who use the clay to make moulds in which to cast the finer specimens of silversmith's work; and it is also made into plastic material for fashioning some of their earthenware gods, while in India it is also used for polishing purposes.

In Australia the large mounds are often demolished for the sake of the clay they contain; it is mixed up with water and made into sun-dried bricks for building houses, while beaten up into mortar it makes excellent floors; both here and in South Africa the smaller ones are turned into baker's ovens after the interior has been burnt out.

Another remarkable thing about the termites is that no matter how dry the season, or parched up the country, if a nest is broken no time elapses before it is mended with damp clay, while the nest always contains a certain amount of moisture, without which the termites could not exist. The question then arises, how do they manage to retain this humidity in a rainless and dewless country? Dr. Livingstone† remarking on this in South Africa, says:—"Can it be that they have the power of combining the oxygen and hydrogen of their vegetable food by vital force so as to obtain water?"

The internal structure of the "Magnetic Nests" of Port Darwin, the large round topped ones of the North-West, and the pyramidal shaped ones of Cape York, though differing very much in their external architecture, all, with slight modifications, agree with the Shoalhaven termitaria in their internal structure.

The next group of termite nests are formed by the members of the genus *Eutermes*, which form a very distinct group, in which the soldiers, instead of having double scissor-like jaws, are provided with heads prolonged into pike-like foreheads which gives them the name of "nasuti" soldiers. It was at one time a

* Sir J. Emerson Tennant. Sketches of the Nat. History of Ceylon, chap. xi. 1861.

† Dr. Livingstone. Missionary Travels and Researches in South Africa, London, 1857.

common idea that some nests contained both pike-headed and scissor-jawed soldiers, but it is now known that this is not the case, the *Eutermes* communities being quite distinct from those with double-jawed soldiers.

The *Eutermes* build two kinds of nests, or rather similar nests in different situations, either terrestrial or arboreal. Those built on the ground are most common about Sydney, and are formed over a small stump, never more than two to three feet and a half in height, perfectly round at the base, with the summit rounded and dome-shaped. They are generally dark brown or black, even the outer surface being an admixture of earthy and woody matter, and often with hardly any earth in their composition. There are no enveloping walls. The true nest starts from the surface, the whole being full of cells and chambers, though they are fewer and the nest much harder and tougher on the surface; working towards the centre the soft papery structure (similar to that of the large nests) is found—"the nursery." The queen and eggs are not very far away from the nucleus, but the terraced portion is not of the same regular formation as that of the large nests, and there is virtually no distinct "royal chamber," but the queen is found about the centre of the low, flat chambers. In one nest I found three well-developed queens, all laying eggs; and within three or four inches of each other but separated by overlying terraces. The bulk of all these nests is almost all woody matter which has been passed through the bodies of the termites and been voided by the workers; yet if a terrestrial nest be cut down on one side they will rebuild it with grains of sand or earth cemented together with excreta. Ridley,* speaking of the Malay Peninsula, says that the termites do not live in the sandy soil. This is not the case in Australia, for I have found *Eutermes* nests in almost pure sand at Botany Bay, near Sydney, which though when first opened were constructed of woody matter, yet two months afterwards one was rebuilt with sand cemented together into a solid mass.

* H. N. Ridley. The Flora of Eastern Malaya. Trans. Linn. Soc. Vol. (2nd Ser.) iii. p. 270, 1893.

Another nest was found upon the summit of a rock at Manly, near Sydney, apparently built over the stump of a small tree that had been growing in a cleft of the rock. A number of covered galleries led down over the face of the rock into the ground, and in several places where they passed over a sharp angle the covered ways were transformed into tubular bridges from point to point; these galleries averaged from $\frac{1}{2}$ to a $\frac{1}{4}$ of an inch in breadth and were constructed entirely of vegetable matter. When one of the galleries was broken the soldiers rushed out in a small body, scattering on either side of the damaged roadway; after hunting about on the surface of the rocks, they then retreated to the breach, which they all entered and formed a rank along either side, standing just far enough apart to touch the tips of each other's antennæ. While they stood in this regular line with their heads up and their antennæ moving backwards and forwards, the workers appeared, each carrying in its mouth a bit of wood or fragment from the wall, and, passing between the soldiers who were standing guard, deposited its burden upon the edge of the wall and turning round evacuated a small drop of dark brown liquid from its anus upon the top of its brick and then disappeared, the next one taking his place and going through exactly the same performance, an endless gang of workers following each other and rapidly reducing the size of the hole; a gap about an inch long and half an inch deep was rebuilt in half an hour. Unlike the two-jawed termites, which never rebuild their nests in the daytime, the *Eutermes* do not seem to dislike the light, but will expose themselves in the hottest sunlight when mending their nests.

The nest upon the rock at Manly was partly demolished and a small queen obtained from the centre in February, and about three months afterwards was found rebuilt, the material being all woody matter, crisp and thin, and cutting up like egg shell. I have seen one of these nests built on the top of a gate post, another upon the top of a pile in a bridge, the termites having formed it under the iron cap in the cavity between it and the top of the pile; it lifted off in a single mass like a small cheese.

Many of the *Eutermes* nests are built in trees, sometimes upon a dead tree, the dead branch of a live one, the rough-barked Eucalypt being generally chosen, as the galleries coming up from the ground are skilfully hidden in the inequalities of the bark, though when they do come to a bare surface they go straight ahead, forming a regular uniform covered way. Not only is there a constant stream of workers and soldiers passing up and down the galleries, but the enormous amount of life one of these arboreal nests contains is something astounding; there seem to be more termites than nest material when they are first broken open.

The dark, almost black, colour of the nests makes them very conspicuous objects on a bare leafless tree. Arboreal-nesting species of this genus have been described from many parts of the world; in Brazil the nests are known as "negro heads." Moseley* gives a description of them at St. Thomas (Virgin Islands) and states that they are often as big as a small hogshead. Hubbard† has worked up the arboreal species of Jamaica; and Miss Ormerod‡ has noted from British Guinea large spherical nests encircling the branches of trees.

In the third group of termites I include those that do not build mound nests, but live in communities under logs, stones, and all sorts of dead wood and timber. A number of our species never appear to build any well-defined nest, but like wandering gypsies, pitch their settlement in any suitable place, like the common American species, *Termes flavipes*, the real nest and queen of which are yet unknown. While some of them form regular little families distinct in themselves, others are predatory bands which find a suitable place to form an encampment and devour everything they can find; they are frequently connected with a large nest at some distance, to which they all retreat when disturbed.

* H. N. Moseley. Notes by a Naturalist on H.M.S. Challenger, p. 12, n. ed. 1892.

† H. G. Hubbard. Proc. Bost. Soc. xix. p. 267, 1878.

‡ Miss E. A. Ormerod. Proc. Ent. Soc. 1881.

However, different localities seem to give them different habits, for the mound builder of the Shoalhaven district is the same species as that which does most of the damage to the wood-work of the houses about Sydney, yet I have never been able to find a mound formed by them within thirty miles of Sydney, though it is the commonest species of this neighbourhood, being found under stones, logs, bark, and in tree trunks.

About the middle of last year it was discovered that the white ants were in the floor of the Record Room in the offices of the Department of Education in Bridge-street, where I had an opportunity of seeing the method of attack.

I found that the floor, which was old and attacked with dry rot in places, had been riddled all along the hard gum (probably iron-bark) joists for a distance of 15 to 20 feet all round what had evidently been the centre of the nest, as a great mass of clay had been raised up from the ground between two joists round which the timbers were perfectly honeycombed. The nest and timbers round it were full of soldiers, workers and young winged forms, but I saw no sign of a queen, though as the floor had been uncovered the night before this was hardly to be wondered at. This nest, I should think, had been under the floor for some years; and it was only from their beginning to eat through the hardwood flooring boards that the termites were noticed.

On several other occasions I have obtained specimens taken out of buildings, and it has always proved to be the same species. Sometimes they attack only a single board or joist and then leave the place, but at other times they eat on till disturbed. Mr. Chisholm, of Torrens Creek, North Queensland, tells me that they are easily frightened by thumping against the board or wall they are destroying, and run back, huddling together like a flock of frightened sheep. No timber is really termite-proof unless protected, for though they have a marked preference for some woods, yet if they cannot get what they like they take the nearest; thus in Normanton *Melaleuca* is said to be ant-resisting, yet further down the Flinders they show a marked preference for it. The Jarrah (*Eucalyptus marginata*) of Western Australia is another

reputed termite-proof, but I have a portion of a plank, received from Mr. C. French, of Melbourne, which has been half consumed by them. The Leichhardt tree of Queensland is also quoted, but at Dalrymple, N.Q., I have seen large logs taken out of an old house riddled with their holes. About Sydney when attacking houses they will seldom touch red wood if there is any clear pine. I have seen a piece of red wood that was nailed to a clear pine board, the latter being only a shell while the former was only slightly grooved by them on the outer surface.

I have noticed that about the neighbourhood of Croydon while nearly every old hardwood fence shows their ravages more or less, they seldom seem to attack soft wood picket fences. But the hardness of wood is no impediment to them. They show a marked preference for the stumps and logs of dead Eucalypts over those of wattle, Casuarina, and the smaller forest trees. Near Hornsby I found them at work on the trunk of a large dead white gum that was as hard and solid as bell metal; they had come up from the ground beneath the roots and just below the surface, boring straight into the wood and then turning upwards, cutting a clean cylindrical tunnel a quarter of an inch in diameter. It is therefore not surprising that they sometimes gnaw holes in sheet lead, which is much softer than many woods attacked by them.

White ants are in many instances introduced into buildings in the city and suburbs by means of fire-wood; during this last season I have exhumed three large family parties, containing enough soldiers, workers and immature winged specimens to found a very respectable colony; these insects would remain in the log probably until the early part of the summer and then migrate to more roomy quarters. They will live for several months in a tightly closed up tin or tube without any further attention, and though they cannot live more than two hours in sea water and a little longer in fresh, yet in the heart of a dead log they might float or drift a considerable distance without being destroyed.

In conclusion, I must tender my thanks to the following correspondents :—Messrs. G. McD. Adamson, of Uralla; Norman Ethridge, Colo Vale; F. B. Miller, Moree; S. Russell, Bowral; H. Rumsey, Barber's Creek; J. Mitchell, Narellan; and my father

(G. W. Froggatt), Shoalhaven, from all of whom I have received notes and specimens. From Victoria, Mr. G. S. Perrin (Conservator of Forests); Mr. J. L. Billingshurst, Castlemaine, and the Curator of the National Museum have assisted me. For Queensland species I am indebted to Mrs. Black, Lolworth Station; Mr. J. R. Chisholm, Torrens Creek; H. E. S. Stokes, Normanton; Mr. Gilbert Turner, of Mackay; and Mr. De Vis, the Curator of the Brisbane Museum.

From the Northern Territory I am in receipt of photographs of the nests and the species forming them taken by Mr. N. Holtze, the Curator of the Botanical Gardens at Port Darwin; while Museum specimens have been forwarded by Mr. J. G. O. Tepper, of Adelaide.

I have had a great number of promises of assistance from various residents in Western Australia, but as yet have only received one lot, but a very interesting collection; from Mr. W. O. Mansbridge, the Warden at Hall's Creek, Kimberley, N.W. Australia.

Though two species are described from Tasmania, I have been unable to enlist anybody to collect specimens.

From New Zealand I am indebted to Captain Hutton and Mr. T. F. Cheeseman for placing me in communication with Captain Broun (the Government Entomologist), who has sent me specimens of two species described by Brauer.

From America I have been generously assisted with named specimens from Mr. L. O. Howard (the State Entomologist) and Mr. H. McE. Knowler, of the Johns Hopkins University, while Mr. S. S. Scudder, Dr. Packard and Mrs. Dudley have forwarded me papers on these insects.

Mr. D. Alcock, of the Indian Museum, Calcutta, sent me specimens of *Termes taprobanes*. The Director of the K. K. Naturhistorisches Hofmuseum in Wien sent me co-types of F. Brauer's named species from Australia, collected by the Novara Expedition in 1868.

I have Professor B. Grassi and Dr. A. Sandias' splendid Monograph upon the Termites of Catania sent me by the authors, while Mr. W. F. Kirby, of the British Museum, has examined a series of specimens sent to him, and promised me any assistance in working them out.

MELIOLA AMPHITRICHA, FRIES.

By D. McALPINE.

(Communicated by J. H. Maiden.)

(Plate xxxi., figs. 1-5 of the upper division of the Plate.)

Spot-like, sooty patches on leaf-stalks, stalklets, and upper and undersurface of leaflets, usually separate, occasionally run together.

Mycelium chestnut-brown and hyphae thick-walled, septate, branched, $7\ \mu$ broad, with short, stout, ultimate branchlets. Appendages dark chestnut, thick-walled, rigid, erect, bluntly pointed and septate, the septa not always distinctly seen on account of the thickness of the walls.

Perithecia black, globose, slightly warted, about $200\ \mu$ in dia.

Asci roughly fig-shaped, two-spored, transparent.

Sporidia grub-like, usually 4-septate, constricted; chestnut-brown, $37\text{--}45 \times 14\text{--}17\ \mu$.

On leaves of *Dysoxylon rutum*, Benth., from Richmond River, New South Wales (Maiden).

The sporidia of this specimen are rather shorter and stouter than the normal, but otherwise the characters agree with those of the above species.

This species is new for New South Wales.

EXPLANATION OF FIGURES.

Fig. 1.—Lower surface of leaflet, showing spot-like mycelium (nat. size).

Fig. 2.—Perithecium burst ($\times 115$).

Fig. 3.—Appendage ($\times 115$).

Fig. 4.—Hyaline ascus with slit ($\times 115$).

Fig. 5.—Sporidia ($\times 600$).

NOTES ON *UROMYCES AMYGDALI*, COOKE : A
SYNONYM OF *PUCCINIA PRUNI*, PERS.
(PRUNE RUST).

By D. McALPINE.

(Communicated by J. H. Maiden.)

(Plates xxxi., lower division, xxxii. and xxxiii.)

I have purposely placed the synonym first, because the fungus which it represents is still considered by Dr. Cooke, one of the authors of the name, a new one, and it will be part of the object of this paper to show that the Australian species thus named in Dr. Cooke's "Handbook" is really the same as that described by Persoon in his "Synopsis Methodica Fungorum" towards the end of last century.

This leaf-rust is of great economic importance, since it attacks such valuable fruit trees as the peach and nectarine, plum and apricot, cherry and almond, causing them prematurely to shed their leaves, and, as a consequence, either to bear no fruit or only small quantities of an inferior kind. As the peach-tree forms its fruit on the previous season's wood, it is evident that the succeeding crop will be affected as well, hence it is highly desirable to know the true nature and the right affinities of this fungus, thereby to be the better able to follow its life-history and to prevent its further spread.

HISTORY OF NAME.

The Australian fungus to which Dr. Cooke assigned the name of *Uromyces amygdali* was collected by H. Tryon, Government Entomologist of Queensland, in February, 1886, on peach and almond leaves, and forwarded almost immediately to Dr. Cooke for identification. As indicated in his "Handbook of Australian Fungi," this name had previously been used by him in Ravenel's "Fungi Americani Exsiccati," issued between 1878 and 1882.

The same name had also been used by Passerini in his "Erb. Critt. Ital." issued in 1873, and Cooke regards this fungus as identical with the one named by him. However, Passerini* subsequently in 1887, on further consideration, pronounced this to be the stilbospore condition of *Puccinia pruni*, Pers. This name of *Uromyces amygdali* is now being used in the different Colonies, having such a high authority at the back of it, but as we shall presently see, it is a misnomer, or rather a synonym of *Puccinia pruni*, Pers., as already decided by Passerini.

Puccinia pruni-spinosae was first employed by Persoon in his "Synopsis Methodica Fungorum," published in 1797, the specific name being derived from the host-plant, *Prunus spinosa* or black-thorn, but as the fungus is now known to have different hosts belonging to the genus *Prunus*, the *spinosa* is dropped as a matter of convenience.

Next, Link in his "Species Fungorum," published in 1825, named the same fungus *Puccinia prunorum*. *Uromyces prunorum*, Lk., var. *amygdali*, Vize, was applied by J. E. Vize† to a Californian specimen on peach leaves in 1878, and the same name was used by the Rev. C. Kalchbrenner‡ for a fungus on peach leaves from Caffraria in 1882. Next, in 1883, Dr. Cooke§ recorded *Puccinia prunorum*, Lk., for Victoria, then in 1886 *Uromyces amygdali*, Cooke, for Queensland, and finally in his "Handbook of Australian Fungi" for Queensland, Victoria and New South Wales on peach and almond leaves in 1892. It was suggested in Tryon's "Report on Insect and Fungus Pests"|| that this fungus belonged to *Puccinia pruni*, but Dr. Cooke repudiates the suggestion in the "Handbook," and with dogged determination sticks to his point in the following note: "We decline to accept this as agreeing with any form of *Puccinia pruni* with which it is commonly associated."

* Nuovo Giornale Botanico Italiano. Vol. x. p. 255, 1887.

† Grevillea, Vol. vii. p. 12, 1878.

‡ Ibid. Vol. xi. p. 19, 1882.

§ Ibid. Vol. xii. p. 97, 1883.

|| p. 98, 1889.

In order to make sure that we were dealing with the same fungus, I have examined peach leaves with the fungus named by Cooke himself in the Herbarium of the Government Botanist, and there is no doubt as to the identity of the specimens. Further, Mr. Tryon has very courteously sent me specimens of peach leaves similar to those formerly submitted to Dr. Cooke, and on which the name was based, with this important difference, however, that the original specimens were collected in February, while these are dated June.

In addition to this, specimens on peach, plum, apricot and almond leaves had been sent from South Australia to the United States Division of Vegetable Pathology, and it was reported in the Journal of Mycology for 1890 that these specimens agree in every particular with those of *Puccinia pruni*, Pers., on peach and plum hosts in the United States, nevertheless his own name was still retained by Dr. Cooke.

As the leaf-rust is unfortunately becoming, or rather has become, very prevalent and a very serious pest to the fruit-grower, it is at least advisable to agree upon some common name, to have uniformity of nomenclature in the different Colonies, so that when dealing with it therapeutically we may be agreed as to the cause of the disease dealt with. And not only so, but the name here has an important bearing when it enables us to recognise the useful fact that the rust in our orchards and the rust in our wheat-fields are but different species of the same genus (*Puccinia*), and that whatever prevents the disease in the one case is likely to be efficient in the other.

A further necessity exists for accurate scientific determination of this fungus from the fact that it is very commonly called "Peach Yellows" on account of the yellow blotches or freckles on the upper surface of the leaf, but it has no connection with the dreaded American disease so-called, which is believed to be, after years of investigation, due to Bacteria.

In the plum the spots assume a much darker colour, and the numerous pustules on the undersurface of the leaf sometimes give it the appearance of being coated with brown mud.

FIRST APPEARANCE IN THE COLONIES.

It is interesting and useful to trace the first appearance of any disease in our midst, to serve as a lesson for the future. Since 1891, when my first report was made upon it, this disease of the peach and allied trees has been constantly under notice. In certain fruit-growing districts it was only observed during season 1890-91 for the first time, but Mr. Neilson, of the Royal Horticultural Gardens, Burnley, informs me that the disease was observed there about 1887, and he had heard of it in the Fern-tree Gully district about 1885 or 1886. In the season of 1887-88 it was also reported for New South Wales, and in season 1889-90 it affected a large number of peach trees there, as stated in Dr. Cobb's article upon it in Ag. Gaz. N.S.W. Vol. i. Pt. 1, 1890, and the disease has been spreading ever since.

I am informed by Mr. Molineux, F.L.S., Secretary to the Agricultural Bureau of South Australia, that the first public reference to this disease was made by the late Frazer Crawford during May, 1890, in the "Garden and Field," as having been observed for the *first time* on peach trees, and he had little doubt that it occurred some time before, but on plum trees. The reference in Garden and Field, Vol. xv. p. 134, 1890, is worthy of quotation:—"This season for the first time I observed it (*i.e.*, *Puccinia pruni*) on a peach tree—or at least what I take to be the same fungus. The lower two-thirds of a large Peach tree has every leaf spotted by it, and as they are very numerous and bright yellow they give a variegated appearance to the foliage. . . . Strange to say, in a neighbour's garden, which has a number of plum trees all more or less attacked, there are a couple of peach trees untouched."

It is also present in Tasmania, although Mr. Thompson, the Govt. Entomologist,* does not refer to its first appearance there, and Mr. Tryon's discovery of it in Queensland in February, 1886, is undoubtedly the first definite record of its appearance in the Colonies.

* A Handbook to the Insect Pests of Farm and Orchard. Depart. of Agriculture, Tasmania, Bull. i. p. 29, 1892.

It is highly probable that the disease has been with us for some time and gradually gaining ground before attracting attention to its cause, for I have even known its effects to be confounded with the tints of autumn, and this seemed all the more plausible as it is usually associated with the shedding of the leaves.

TIME OF OCCURRENCE.

The time of appearance varies in different seasons, and the later it is the less damage it does. It also varies in its virulence according to the nature of the season. Thus in the Royal Horticultural Gardens the attack was very mild in 1888-89, then very bad in 1889-90, not very bad in 1890-91, and speaking for the Colony generally the past season was favourable to its spread. A grower in the Goulburn Valley writes:—"This season (1894-95) owing no doubt to the continued rains of the spring and the very heavy downpour in January, the attacks of this fungus have been very serious, causing a very large proportion of the leaves of the peaches to fall prematurely. Many acres of trees were thus laid bare for about 18 inches from the crown, only the younger wood surviving, and as a consequence nearly all the fruit for the coming season must come from near the top. Plums and prunes suffered severely, many trees being completely denuded of foliage by March." Thus, the disease seems to be intermittent in its character according to the prevailing weather. The following table shows the rainfall for the critical months:—

	Average for 1888. over 30 years.		1889. Average.	1890. Average.
November	0·62in.	2·50in.	4·27in.	2·48in.
December	2·72	2·35	1·52	2·50
	1889.		1890.	1891.
January	4·22	1·79	1·37	1·86
	7·56in.	6·64in.	7·16in.	6·84in.
Disease at Hort. Gardens... }	Mild.		Bad.	
			Mild.	

The above table shows that it is not a mere matter of moisture which settles the greater or less prevalence of the disease, but other conditions, such as accompanying heat or cold, will also influence it.

Generally the spores are plentifully produced about the beginning of the year, and the leaves have usually all dropped off by April. It is very noticeable how the leaves fall away from the lower ends of the branches, leaving only a small tuft of leaves at the top, which may be regarded as the expiring effort of nature to renew the foliage of which the tree is prematurely deprived

HOSTS AND PARTS ATTACKED.

I have found the fungus in Victoria on the leaves of the peach and its smooth-skinned variety the nectarine, the plum, the apricot and the almond. It is most prevalent on the plum and peach and comparatively rare as yet on the apricot and almond. In other parts of the world the disease is found on other species of *Prunus*. In California it attacks the cherry in addition to the above, and in the old world it is found on the sloe or blackthorn (*Prunus spinosa*), and other species. Although this fungus has only been known elsewhere to attack the leaves, I had a specimen sent from Wangaratta in which the fruit was affected. It was very noticeable that only one side was attacked, and presented the appearance of a number of pimples or blisters of a brownish colour. The fungus was evidently not so far advanced as on the leaves, so that the conspicuous rusty colour was not so apparent.

In South Australia the disease has been found on the peach, plum, apricot and almond leaves, as well as on the *fruit* of the apricot. The latter specimen was kindly sent to me by J. G. O. Tepper, F.L.S., for determination, and he was naturally surprised to find the leaf-rust become a fruit-rust. It is rather peculiar that no previous record of such a comparatively common rust should be known on fruit outside of the Australian colonies, but it only shows what a glorious climate we have for luxuriant growth, that of fungi included, and it points to the grave danger of allowing fungus pests to run rampant, for they may attack

quite a variety of fruits here to which they were formerly strangers.

As might be anticipated, this fungus has its peculiarities of attack. In my own garden, for instance, the peach and plum trees were badly affected, while an apricot whose branches interlaced with an affected peach tree had not a speck upon it. In the Royal Horticultural Gardens, Burnley, apricot and almond trees are as yet unaffected, and in 1890-91 not even plums were attacked, only peaches. J. G. O. Tepper, of Adelaide, informs me that in his garden the apricots are very badly affected year after year, peaches to a slightly less extent, and a plum tree with the branches touching other diseased trees is wholly unaffected. In contrast to this, there is the case already mentioned where the peach trees were unaffected and the plum trees more or less attacked. No doubt the variety of the respective trees will have an important influence on the immunity from or liability to disease.

VARIETIES MOST AFFECTED.

In the Royal Horticultural Gardens, Burnley, where so many different varieties are grown, I was able, with the assistance of Mr. Neilson, to select some of those most affected. Kerr's Slip-stone, Royal George and Crimson George are very liable among peaches, and Darwin and Dante among nectarines. Seedling peaches are also badly attacked.

Plums such as Late Harvey and Imperial Ottoman were pretty bad, and it was very noticeable that all those provided with thorns, such as the French Cherry Plum, seemed to enjoy comparative immunity from the disease.

DISTRIBUTION.

This disease has a very wide distribution, possibly co-extensive with the cultivation of the peach and allied fruits. It has actually been found in Britain, France, Germany, Italy, Austria, Belgium, Switzerland, North America, Canary Islands, India, Cape Colony and Australia. As regards its local distribution in Victoria, it extends from the Murray to the sea—from Rutherglen in the north to Warrnambool in the south.

INVESTIGATIONS.

I have examined a large number of specimens this season from different districts and have found the fungus, as already stated, on peach, nectarine, plum, apricot and almond. I have also specimens from the Herbarium of the United States Department of Agriculture, through the courtesy of B. T. Galloway, Chief of the Division of Vegetable Pathology, and these may be taken as a starting point.

On the leaves of *Prunus americana*, the plum of North America (3rd Oct., 1889), there is nothing to be found but two-celled teleutospores, while on the leaves of another species of *Prunus* (28th Sept., 1889) there are a few uredospores, but the great majority are teleutospores. Fig. 1 shows (*a*) the uredospore which is yellowish-brown in colour, (*b*) paraphysis which is of a pale lemon-yellow colour, and (*c*) teleutospores which are of a dark brown, the lower equally so with the upper, but in many cases paler. There is no doubt but this fungus is *Puccinia pruni*, Pers. In the Victorian specimens the presence of two-celled teleutospores will settle the point that the fungus is not a *Uromyces*, and the teleutospores are common enough, so that it is a *Puccinia*. But if the peach leaf is examined in the summer season and even up to July in many cases, only one kind of spore will be found—the uredospore. And even on the plum leaf in the month of March I was unable to find a single teleutospore.

On the peach leaves sent from Queensland by Mr. Tryon I found both uredospores and teleutospores (figs. 2 and 3). The uredospores were of the normal shape and varying in size from 28 to 31 μ long $\times$ 14 to 16 μ broad. The teleutospores were also normal, varying from 25 to 34 μ long $\times$ 17 to 20 μ broad, and the pedicels were short and transparent. By gentle pressure the two cells of the teleutospore can be readily separated, and in fact they often fall asunder in the process of mounting. The upper cell seems to be more brittle than the lower, as it is often broken up under slight pressure, while the other usually remains intact. I have drawn a lower cell (fig. 2*c*) separated by gentle pressure,

and it looks so rounded at the point of junction with the upper cell that one might readily mistake it for an independent, unicellular, stalked spore.

It would appear, however, that on the continent of Europe the teleutospore form is the prevailing one, for De Bary* speaks of *Puccinia pruni* belonging to the *Micropuccinia*, as teleutospores only are known.

No doubt the absence of teleutospores helped to mislead Dr. Cooke in his determination, and such a case emphasises the necessity for continuous observation of many of these fungi on the spot, in order to determine accurately their affinities, for at certain seasons only the uredospores are present, as in this instance, or it may be that the teleutospores only are present as in the case of *Puccinia burchardiae* determined by Dr. Saccardo where I had to supplement the description with that of the uredospores.†

A few brief notes may now be given on each of the Victorian hosts mentioned, in order to show that it is the same fungus disease which affects them all. *Puccinia pruni*, Pers., has to be recorded as new to Victoria for the apricot.

Peach.—Leaf-rust on the peach has been very prevalent this season, and yet the teleutospores are comparatively rare in the specimens which I have examined even in the month of July. A number of leaves were examined from peach trees in my own garden, but no teleutospores were found, only uredospores (fig. 6). In one instance the uredospore had germinated on the leaf still attached to the tree as shown in fig. 5. On some peach leaves from the Royal Horticultural Gardens, teleutospores were found, but not in great quantity, along with uredospores. I have just examined (July 3rd) some leaves from young trees of Bidwell's Late, Improved China Flat, Red Ceylon, &c., and while there is abundance of uredospores there are no teleutospores. The pustules containing teleutospores and uredospores mixed may be readily

* Comp. Morph. and Biology of the Fungi, p. 285 (1887).

† Vict. Nat. x. 192 (1894).

recognised by the dark brown almost black appearance in contrast to the rusty-brown pustules containing uredospores alone.

Nectarine.—On the leaves of a nectarine (Dante) from the Royal Horticultural Gardens teleutospores were found, agreeing closely with those on peach (fig. 6) as well as on the variety called Darwin.

Plum.—On plum leaves from the Gardens, only comparatively few uredospores were found, while teleutospores were plentiful (fig. 7).

A specimen of plum leaf with rust upon it, plucked on May 19th, was sent from Hobart by Mr. Rodway, and both uredospores and teleutospores were found upon it (fig. 8).

Apricot.—The rust on the apricot leaf is still comparatively rare in Victoria. I am indebted for specimens to an indefatigable worker, Mr. G. H. Robinson, of Ardmona, who sent them as far back as June 23rd, 1894. The teleutospores were not numerous among the uredospores, and one is shown in fig. 9.

In Mr. Tepper's specimen on the fruit forwarded early in January, only uredospores were found (fig. 10). The skin of the apricot had small yellowish to brownish blotches over it, and the uredospores are seen to be of the normal type, but sometimes rather elongated, even attaining a length of 44μ . On the other hand, they are sometimes excessively shortened, and the extremes of length, 26 to 44μ , were met with in this one specimen. They are, however, in relatively small quantity, and I am inclined to think that the close-set, downy hairs interfered with their proper development. When a microscopic section of the skin is made, only a few uredospores are seen with difficulty among the hairs, attached to the matrix.

Almond.—As in the case of the apricot, the fungus is also very scarce as yet on the almond in Victoria. On June 17th of last year, Mr. Robinson found at Ardmona only a few leaves, and each with one pustule containing uredospores which are shown in fig. 11.

I had also specimens from Netherby in December, 1893, and the undersurface of the leaves had quite a rusty appearance, owing

to the numerous pustules, which contained teleutospores as well as uredospores (fig. 12). Curiously enough the almond leaves sent in June from Ardmona in the Goulburn Valley contained only uredospores and these sparingly, while almond leaves from Netherby in the extreme west of the Colony, but practically in the same degree of latitude, contained both uredospores and teleutospores in abundance.

After diligent search in the Royal Horticultural Gardens, Burnley, I cannot find any trace of the fungus on the almond leaves there, and nine different varieties are grown.

From a comparison of the uredospores and teleutospores on the above different species of *Prunus*, there can be no doubt of their identity or of their being *Puccinia pruni*, Pers.

Further, the summer-spores (uredospores) are produced in great profusion, commencing as a rule in December and January, succeeded by the winter-spores (teleutospores) in May and June, which represent with us the end of autumn and the beginning of winter. In the uredospores the apex is not perforated by a single germ-pore as in *Uromyces*, but there are at least two lateral germ-pores. The teleutospores as noted in the British species are apt to separate at the septum, so that numerous unicellular spores are often to be seen, which might easily on a cursory glance be mistaken for something else. Hitherto the teleutospores are to be found most plentifully on plum leaves in Victoria, and much more sparingly on the others.

GERMINATION OF SPORES.

Both uredospores and teleutospores have been kept for some time in a moist chamber and only uredospores have germinated. This is in keeping with what we already know of this fungus, that it belongs to the group *Hemipuccinia*, having uredospores and teleutospores, the latter only germinating after a period of rest. No nutritive solution was used to stimulate germination, only water (fig. 13).

There was an average temperature of from 10° to 12° C.

The fate of the teleutospores has not yet been traced. As showing the practical importance of studying the life-history of these

parasitic fungi and the utility of such knowledge to the grower, I cannot do better than quote from a letter recently received from Mr. George Quinn, Inspector under "The Vine, Fruit and Vegetable Protection Act," South Australia. He writes (May 28th, 1895):—"The disease (*Puccinia pruni*) has been very prevalent in our orchards in all parts of the Colony in the season just closing, and I am somewhat in doubt as to how its spores exist over the winter, for in orchards where the peach or plum trees have been thoroughly sprayed with Bordeaux Mixture, with excellent results, as far as the 'curl leaf' is concerned on the former, and I am perplexed as to where the spores find refuge until the autumn when the pustules begin to show on the foliage of the trees. Do you think it possible for the spores which have fallen either before or with the diseased leaves to be ploughed into the soil and then be turned up again with the summer cultivator to rise with the dust among the foliage, and, the conditions being suitable, germinate? Do you think the spores of the various parasitic fungi which injure our fruits would lose their vitality completely if ploughed beneath the soil for a winter? Would they not *keep*, like the seeds of some more highly organized vegetables, for a considerable time?"

To answer the above question, I am testing during the forthcoming season. 1st. if the uredospores retain their vitality and germinating power during the winter, both when lying on the surface of the ground and when buried to a depth of four or five inches; 2nd, at what time teleutospores are capable of germination and how they are affected by being buried in the ground four or five inches deep; and 3rd, if they can produce the disease in an otherwise healthy tree. The answer to these questions will fill up gaps in our knowledge concerning the life-history of this parasite and enable us the more effectually to cope with it.

That the peach leaf rust of Australia is not due to a *Uromyces* should now be conclusively proved, because of the two-celled teleutospores and the uredospores having a transverse band of germ-pores instead of a single apical germ-pore.

TREATMENT.

The treatment must be preventive, and spraying with ammoniacal solution of copper carbonate and modified eau celeste has been found successful in the United States. The improved form of Bordeaux Mixture, as given in Guides to Growers, No. 15 (see Literature at end), has been found effectual with us, and since the lower surface of the leaves is affected, the spraying should be specially directed there.

There is another preventive measure which should never be neglected, and that is the burning as far as possible of the affected leaves in order to destroy the winter spores. So important and so generally applicable is this advice, that the remarks of the late Baron von Thuemen on this particular disease may be quoted in full:—"The surest and most effectual means of combating this rust, as well as other rust fungi, is to destroy the resting-spore generation as far as possible. The purpose of the special spore appearing in the autumn is to tide the species over the winter. On the leaves lying on the ground, even if they are decayed and decomposed, the spore-clusters remain for the most part completely safe. So when the trees put forth their young leaves next year they are infected afresh from the soil, by means of the spores present there in unlimited quantities, on little bits of the leaves hardly recognisable. These spores, on account of their tenacity of life, have received the name of 'resting-spores.' Hence the imperative necessity for the fruit grower to destroy the leaves covered with heaps of spores, in order to prevent fresh infection. This is best done in the autumn when all the leaves have fallen from the tree, and they may then be carefully collected and burnt. Or if this is impracticable, the land under the trees should be deeply dug so that all affected leaves may be buried deeply in the soil, where they can do no further mischief."

Since writing this paper I have seen the Report of Professor Scribner* for 1887 on "Leaf Rust of the Cherry, Peach, Plum,

* Report of the Commissioner of Agriculture, U.S.A., for 1887, pp. 353 to 355.

&c.—*Puccinia pruni-spinosæ*, Pers.," and have incorporated some of his references in the literature of the subject. There are several points in it worthy of comment, as showing the different behaviour of the same fungus under different conditions of existence. After noting that the fungus has been described under several different names, he remarks:—"Some confusion has probably arisen from the fact that the uredo stage alone occurs upon the peach and from the resemblance of the uredospores to the teleutospores of *Uromyces*." Both the uredo-stage and teleuto-stage, as we have seen, occur upon the peach in Australia, nevertheless the latter is comparatively rare and has undoubtedly led to misunderstanding of the true nature of the fungus from the absence of two-celled teleutospores. The uredospores are certainly suggestive of *Uromyces* on a superficial view, but their germination, not by a single apical pore, but by a band behind the apex, excludes the idea.

Again he states:—"The uredospores may or may not be present on the plum, but on the specimens examined a few have been found in all cases mingled with the teleutospores." In specimens of plum leaves described by me in Bulletin xiv. of the Victorian Department of Agriculture in March, 1891, only uredospores were present at that time, while on specimens examined by Professor De Bary only teleutospores were present and no uredospores.

Again he remarks:—"Teleutospores have never yet been found upon the peach, and it is probable that they do not occur upon it at all, since specimens gathered in Texas as late as December 26th failed to show any."

It is rather a strange and striking fact that teleutospores which are commonly regarded as winter spores should occur upon the peach in a climate such as ours and not in America.

To show the thorough agreement between American specimens of *Puccinia pruni*, Pers., and Australian so-called *Uromyces amygdali*, Cooke, I have reproduced some of Professor Scribner's drawings for comparison (fig. 14). They prove conclusively the identity of the two forms and disprove, if such were needed, and in spite of Dr. Cooke's pertinacity, the *Uromyces*-character of

the form under consideration. His *Uromyces amygdali* is simply the uredo-stage of *Puccinia pruni*.

DESCRIPTION.

It only remains now to conclude with a description of the fungus as found in Australia.

Uredospores.—Sori hypophyllous, small, light brown to rusty brown, roundish, scattered but grouped in patches, often confluent, soon naked, pulverulent, seated on yellow spots corresponding to those on upper surface.

Uredospores variable in form, from elongated-ovate to almond-shaped, usually shortly stalked, but sometimes $22\ \mu$ in length, closely echinulate, yellowish, apex yellowish-brown, thickened, with spines less prominent, bluntly conical or rounded, with at least two opposite germ-pores situated just behind thickened apex, $26\text{--}44 \times 12\text{--}20\ \mu$, intermixed with numerous capitate, pale yellow, long-stalked paraphyses, sometimes attaining a length of $60\ \mu$.

Teleutospores.—Sori scattered or confluent, isolated or in groups, punctulate, pulverulent, seal-brown, known from the other by their dark almost black appearance.

Teleutospores composed of two spherical cells, apparently flattened at their junction, lower usually smaller and paler than upper, but sometimes similar in size and colour, sharply constricted in the middle and cells readily separating. Epispore uniformly thick, dark brown, thickly studded with short stout spikes, $25\text{--}37 \times 17\text{--}21\ \mu$. Pedicels short, hyaline, deciduous or persistent, from 4 to $8\ \mu$ long.

On leaves of peach, nectarine, plum, apricot and almond, and occasionally on fruits of peach and apricot: December to June. New South Wales, Victoria, Queensland, S. Australia and Tasmania.

SYNONYMS.

Puccinia pruni-spinosæ, Pers. (1797).

Uredo prunastri, DC. (1805).

Puccinia prunorum, Link (1825).

Uromyces prunorum, Fekl. (1869).

Uromyces amygdali, Pass., (1873), and Cooke (1878-1882).

Uromyces prunorum, var. *amygdali*, Vize (1878).

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COOKE—Rust, Smut, Mildew and Mould. 1st Ed. p. 201, 1865.

Puccinia prunorum, Lk., or plum tree brand, described as common in Britain on plum trees.

FUCKEL—Symbolæ Mycologicæ, p. 50, 1869.

PECK—Twenty-fifth Report of the Regents of the University of the State of New York, p. 116, 1873.

Leaves of wild cherry, *Prunus serotina*, Ehrh. This species seems to be rare.

VIZE—Californian Fungi. Grevillea, Vol. vii. p. 12, 1878.

Uromyces prunorum, Lk., var. *amygdali*, on peach leaves.

FRANK—Die Krankheiten der Pflanzen, p. 468, 1881.

Puccinia prunorum, Link, on leaves of *Prunus persica*, *P. domestica*, *P. insititia*, *P. armeniaca* and *P. amygdalus*.

KALCHBRENNER—Fungi Macowaniani. Grevillea, Vol. xi. p. 19, 1882.

Uromyces prunorum, v. *amygdali* on *Prunus persica*.

COOKE—Australian Fungi. Grevillea, Vol. xi., p. 97, 1883, *Puccinia prunorum*, Link, Victoria.

FARLOW—Notes on some species in the 3rd and 11th centuries of Ellis's North American Fungi. Proc. Am. Acad. Arts and Sci. Boston, xviii. p. 82, 1883.

“As far as my experience goes, the uredospores of *P. prunorum*, Lk., are much less common near Cambridge than the teleutospores, but in the Southern States they are common.”

WINTER—Die Pilze, Vol. i. p. 193, 1884.

Teleutospore of *Puccinia pruni*, figured after Corda at p. 136.

BURRILL—Parasitic Fungi of Illinois. Part i. Uredineae in Bull. Illinois State Laboratory, ii. p. 177, 1885.

SORAUER—Handbuch der Pflanzenkrankheiten, Vol. ii. p. 226, 1886.

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TRELEASE—Preliminary list of the parasitic fungi of Wisconsin. Trans. Wisconsin Acad. Sci. Arts. vi. p. 24, 1886.

Uredo- and teleutospores recorded on leaves of seedling *Prunus americana*, Marsh, as well as on older leaves of same species and of *P. virginiana*.

DE BARY—Fungi, Mycetozoa and Bacteria, p. 285, 1887.

Puccinia pruni given as belonging to *Micropuccinia*, in which only teleutospores are known.

ARTHUR—Bulletin of Iowa Agricultural College, p. 159, 1887.

SCRIBNER—Report of the Commissioner of Agriculture, U.S.A., for 1887—Section of Vegetable Pathology, pp. 353 to 355.

Description and drawings of *Puccinia pruni-spinosæ*, Pers.—Leaf-rust of the cherry, peach, plum, &c.

DIETEL—Verzeichnis sämtlicher Uredineen nach Familien ihrer Nährpflanzen geordnet. Leipzig, p. 31, 1888.

Puccinia pruni-spinosæ, Pers., on *Prunus persica*, *P. spinosa*, *P. armeniaca*, *P. insititia*, *P. domestica*, *P. virginiana*, *P. americana* and *P. serotina*.

SACCARDO—Sylloge Fungorum, Vol. vii. p. 648, 1888.

Puccinia pruni, Pers., described and Synonyms given as *Uromyces amygdali*, Pass., in Erb. Critt. Ital., &c. On *Prunus amygdalus*, *P. domestica*, *P. armeniaca* and *P. persica*.

VON THUEMEN—Die Pilze des Aprikosenbaumes (*Armeniaca vulgaris*, Lam.)—Eine Monographie. Klosterneuberg, pp. 8 and 9, 1888.

Puccinia prunorum, Lk., on apricots and plums, the uredo- or stylospore form occurring in the height of summer, and, some time after, the teleutospores.

BAILEY—Second Supplement to Synopsis of the Queensland Flora, p. 126, 1888.

Uromyces amygdali, Cooke, on almond and peach leaves.

HALSTED—Bulletin Iowa Agricultural College, 1888.

FARLEY AND SEYMOUR—A provisional Host-Index of the Fungi of the United States. Vol. i. p. 32, &c., 1888, and Vol. iii. p. 197, 1890.

Synonymy and Hosts of *Puccinia pruni* given.

PLOWRIGHT—British Uredineæ and Ustilagineæ, p. 192, 1889.

Puccinia pruni, Pers., on *Prunus spinosa*, *P. domestica*, and *Rhamnus catharticus*.

TRYON—Report on Insect and Fungus Pests, Brisbane, p. 97, &c., 1889.

Uromyces amygdali, Cooke, a new fungus determined by Dr. Cooke, on peach and almond leaves, Queensland.

BRUNK—Bordeaux Mixture for the Plum Leaf-blight. Journal of Mycology, p. 38, 1889.

Peach and plum trees affected with *Puccinia pruni-spinosæ*.

ANNUAL REPORT—State Board of Horticulture of California for 1889.

EARLE—Experiments with Fungicides for Plant Diseases. Bull. ii. Veg. Path. Sec. U.S.A., p. 38, 1890.

Notices injury to peach and plum leaves from Bordeaux Mixture applied for rust: *Puccinia pruni*, Pers.

ANDERSON—Notes on certain Uredineæ and Ustilagineæ. Journal of Mycology, p. 125, 1890.

Uromyces amygdali, Cooke, agrees in every particular with *Puccinia pruni*, Pers., on peach and plum hosts in the United States.

COBB—Peach-rust in Orchards. Ag. Gaz. N.S.W. Vol. i. Pt. 1, p. 93, 1890.

Uromyces amygdali, Cooke, identical with *Puccinia pruni*, Pers.

MCALPINE—Report on Peach and Plum-leaf Rust (*Puccinia pruni*, Pers.). Bull. xiv. Dept. of Ag. Victoria, pp. 138-147, 2 Plates, 1891.

Nature of fungus and remedies given.

COBB—Remedies for Peach-rust. Ag. Gaz. N.S.W. Vol. ii. Pt. 3, p. 157, 1891.

Burning leaves, spraying and application of potash manures recommended.

COOKE—Handbook of Australian Fungi, p. 331, 1892.

Uromyces amygdali, Cooke, in Rav. Fung. Amer.; Pass. in Erb. Critt. Ital., on Peach and Almond leaves, Queensland, Victoria, New South Wales.

THOMPSON—A Handbook to the Insect Pests of Farm and Orchard. Depart. of Ag. Tasmania, Bull. i., pp. 29 and 30, 1892.

Description and treatment given of *Puccinia pruni*.

GALLOWAY—Report of the Chief of the Division of Vegetable Pathology for 1892: U.S. Dept. of Ag. p. 232.

Puccinia pruni-spinosæ on peach, nectarine, apricot, cherry, almond and plum.

SMITH—Field Notes, 1891, in Journal of Mycology, p. 92, 1892.

Uromyces pruni-spinosæ, Pers., appears to prefer thickly planted nursery stock.

BAILEY—A review of the Fungus-blight which have been observed to injure living vegetation in the Colony of Queensland. Report of Fourth Meeting of Aust. Assoc. Adv. Science, p. 400, 1892.

Uromyces amygdali, Cooke, very abundant of late years on the foliage of the peach and allied trees in Southern Queensland.

WEED—Fungi and Fungicides. New York, p. 65, 1894.

Plum-leaf Rust—*Puccinia pruni-spinosæ*. Only mentioned on plum leaves.

PIERCE—Prune Rust: Journal of Mycology, vii., No. 4, p. 354, 1894. Affecting prune, plum, peach, nectarine, apricot, cherry and almond.

Ammoniacal copper carbonate effectual for treatment.

McALPINE—Spraying for Fungus Diseases. Guides to Growers, No. 15. Dept. of Agriculture, Victoria, p. 8, 1894.

Improved form of Bordeaux Mixture a preventive for this rust.

EXPLANATION OF FIGURES.

(Magnified 600 dia. except fig. 14.)

Plate XXXI. (lower division of Plate).

Fig. 1.—*Puccinia pruni*, Pers., from *Prunus* sp., United States.

a, uredospore yellowish-brown, closely echinulate; *b*, paraphysis, pale lemon yellow and long-stalked; *c*, deep dark brown teleutospores studded with short bluntish spines.

Fig. 2.—Uredospores and teleutospores on peach leaf from Queensland—June.

a, uredospore, yellowish-brown, average twice as long as broad; *b*, teleutospore, dark brown, but somewhat translucent; *c*, lower cell of teleutospore detached, showing rounded top.

Fig. 3.—Uredospores and teleutospores of same, mounted dry.

a, group of uredospores, individuals selected from different parts of field; *b*, group of teleutospores found together.

Plate XXXII.

Fig. 4.—Uredospores (*a*) with persistent pedicels and paraphyses (*b*) from peach leaf in own garden—June.

Fig. 5.—Germinating uredospore from peach leaf in own garden—June. There are two germ-tubes, but one is in abeyance.



- Fig. 6.—Teleutospore from nectarine—June.
Fig. 7.—Uredospores (*a*) and teleutospores (*b*) from plum leaf—May.
Fig. 8.—Uredospores (*a*) and teleutospores (*b*) from plum leaf, Tasmania—May.
Fig. 9.—Teleutospore from apricot—June—showing top cell detached and entire.

Plate XXXIII.

- Fig. 10.—Group of uredospores from skin of apricot—showing the widest extremes in length.
Fig. 11.—Uredospores from almond leaf—June.
Fig. 12.—Uredospores (*a*) and teleutospores (*b*) from almond leaf—December.
Fig. 13.—Germinating uredospores from plum leaf, Tasmania—plucked May 19th.
a, after nearly 5 days (4 days 21 hours) in moist chamber; *b*, contents of germ tube vacuolated, and contents of spore turbid; *c*, contents of spore as usual, but contents of tube with minute particles aggregated at intervals; *d*, germ-tube curving upon itself.
Fig. 14.—Uredospores from peach and plum, and teleutospores from plum (after F. L. Scribner).
a, uredospores from peach, stalkless and echinulate; *b*, germinating uredospore from plum, with germ-tube on one side; *c*, teleutospores from plum in surface view showing markings; *d*, the same in optical section.

PUCCINIA ON GROUNDSEL, WITH TRIMORPHIC
TELEUTOSPORES.

By D. McALPINE.

(Communicated by J. H. Maiden.)

(Plates XXXIV.-XXXVI.)

A specimen of Groundsel Rust was sent to me by Mr. Rodway, of Hobart, Tasmania, and found by him there on the 21st April of the present year. The aecidial-stage of the Groundsel Rust is common enough, at least with us at the Royal Horticultural Gardens, Burnley, but as he informs me this is the first and only instance in which he has found the black rust with teleutospores. At present, and indeed throughout the year, there is plenty of Groundsel with aecidia at the Royal Horticultural Gardens, but I have hitherto failed to find any teleutospores, and they are here recorded for the first time in Australia on Groundsel. But last year* I described a *Puccinia* on *Erechtites*, a genus closely allied to *Senecio*, received from Mr. Robinson, of Ardmona, and on comparing the two forms I find that the Groundsel Rust is very similar.

DESCRIPTION.

I. *Aecidiospores*.—Aecidia forming blister-like swellings on stem and branches, on upper and undersurfaces of leaves, on flower-head stalks and involucre, causing discolouration and distortion and usually surrounded by paler green tissue; they are disposed in clusters without any definite order.

Pseudoperidia round, sometimes oval, with white, scalloped everted edges; before opening tubercular.

Aecidiospores spherical, oval or angular, orange-coloured, smooth, average 14-16 μ in dia. or 14-17 $\times$ 12-16 μ . Very common all the year round, except during middle of summer.

* Proc. Roy. Soc. Vict. Vol. vii. N.S. pp. 214-221 (1894).

II. *Uredospores*—not known.

III. *Teleutospores*.—Sori for a long time covered by epidermis, then bursting through and epidermis usually thrown off, or remaining in shreds and patches, intermixed or running parallel with aecidia, black, convex, often confluent in elongated lines, causing swelling of stems, branches, leaves and flower-head stalks and attacking flower-heads.

Teleutospores chestnut-brown, pedicellate, elongated, slightly constricted at middle, variously shaped but usually elongated clavate; upper cell deep chestnut-brown, rounded or somewhat oval, scoop-shaped or truncated, and thickened at apex, $17\text{--}32 \times 15\text{--}25 \mu$; lower cell usually paler in colour, rounded at base or tapering, often elongated relatively to upper, $18\text{--}38 \times 12\text{--}20 \mu$.

Size of teleutospore, $36\text{--}63 \times 15\cdot5\text{--}25 \mu$.

Unicellular and tricellular teleutospores occasionally found.

Unicellular—elongated oval or somewhat elliptical, apex rounded or pointed and usually thickened, smooth, stalked, varying in colour from pale yellow to golden yellow and chestnut-brown, and sometimes colourless at apex. $29\text{--}44 \times 13\text{--}17 \mu$.

Pedicel colourless, persistent and somewhat longer than spore.

Tricellular—elongated club-shape, and generally resembling ordinary teleutospores except in size. $48\text{--}73 \times 22\text{--}25 \mu$.

Pedicels decidedly persistent, pale yellow tint to transparent, sometimes longer than spore, occasionally 63μ , usually stoutish, 5 to 9μ broad.

Aecidiospores on stems and branches, extending from base of stem to topmost flower-head, on upper and undersurface of leaves.

Teleutospores on stems, branches, leaf-stalks, leaves and flower-heads.

On *Senecio vulgaris*, L. Aecidiospores all the year round. New South Wales, Victoria, Tasmania. Teleutospores April, Domain, Hobart, Tasmania (Rodway, 64). Aecidiospores almost all the year round and teleutospores, April to July only in Victoria.

1. The average size of the aecidiospores from Victorian specimens of Groundsel is rather more than from Tasmanian specimens,

which, however, are accompanied by teleutospores. It is not to be inferred on that account that the production of teleutospores intermixed has any influence upon the size of the spores, for I find that the uredospores of *Puccinia pruni*, Pers., are just as large on a leaf producing them alone as when intermixed with teleutospores.

The late Dr. Ralph in a paper "On the *Æcidium* affecting the *Senecio vulgaris*, L., or Groundsel,"* stated that he was able to trace by the use of strong carbolic acid the fine yellow sporular matter into the covering of the seed, the seed itself and the hairs of the pappus. It is interesting, as he points out, to find this in the fruit and its appendages, since the hairy pappus surmounting it would thus carry the fungus far and wide. I have found yellow colouring matter in the hairs of the plant, but have been unable to associate it with the fungus.

The suggestion in the same paper that the source of rust in cereals may be found in the Groundsel, taking the place of the Barberry bush in other countries, is rendered highly improbable from the fact, apart from other considerations, that the teleutospores proper to itself have now been found on the Groundsel, along with the aecidiospores.

III. It has been shown by Dr. P. Dietel† in the case of an allied fungus, *Puccinia senecionis*, Lib., that both kinds of spores—aecidiospores and teleutospores—are produced from one and the same mycelium, just as in *Puccinia graminis*, Pers., the uredospores and teleutospores are similarly produced, so that probably here too aecidiospores and teleutospores have a common origin.

CLASSIFICATION.

This fungus belongs to the group *Pucciniopsis*, Schroet., having aecidiospores and teleutospores on the same host-plant, and the question naturally arises as to what species of *Puccinia* it belongs, seeing that the *Compositae* have such a wide distribution,

* Vict. Nat. viii. No. 2, 18 (1890).

† Zeitsch. f. Pflanzk. Vol. iii. Pt. 5, 258 (1893).

and the common Groundsel is likely to have some well-known rust upon it. Groundsel is an imported weed, probably from Britain, and yet curiously enough the very common Groundsel rust of the old country (*Coleosporium senecionis*, Fries) has not yet been met with here.

In Plowright's "Monograph of the British Uredineæ and Ustilagineæ" the following three Puccinias are given as occurring on species of *Senecio*, but none of them on *S. vulgaris*—

P. glomerata, Grev., (thought to be the typical *P. expansa*, Link).

P. senecionis, Lib.

P. schoeleriana, Plow. & Mag.

The two former belong to the *Micro-puccinia* or those which have teleutospores only, and the latter to the *Hetero-puccinia*, in which there are the three kinds of spores, the aecidiospores being on one host-plant and the uredospores and teleutospores on a different host-plant. Assuming that the complete life-history of the above species is known, our fungus belongs to a different group, but on the Continent of Europe *P. senecionis* is known to produce aecidiospores as well,* and therefore it might be a similar species to ours. But the sori are brown, not black, and that excludes it, while on *P. glomerata* the teleutospores are too small for the present species, and the colourless papilla surmounting the upper cell is absent from ours. So that there appears to be no corresponding fungus on British species of *Senecio*.

Turning now to Farlow and Seymour's "Host-Index of the Fungi of the United States," the following are given on species of *Senecio* there, and here again *S. vulgaris* has only the common British rust already mentioned :—

Aecidium compositarum, Mart.

A. senecionis, Desm.

Puccinia conglomerata, Schm. & Kze.

The Puccinias (for there are several) of which *A. compositarum* is regarded as a stage, belong for the most part to the *Hetero-*

* See Dietel in Zeitsch. f. Pflanzenk. Vol. iii. Pt. 5, 259 (1893).

puccinia, and may therefore be dismissed, so that *P. conglomerata* has only to be considered; of which *A. senecionis* is the recognised aecidial stage. This aecidium is given by Dr. Cooke in his "Handbook of Australian Fungi (p. 342) for New South Wales and Victoria" for *Senecio*, but no species is mentioned; still the presumption is that we have here its Puccinia-stage and so resemblances and differences will have to be carefully noted. The principal points of difference in the aecidial stage are that the aecidia of the Groundsel rust are on pale green spots, not on brown, and are not margined with black, but otherwise there is general agreement, except that their spores are rather smaller. It is in the Puccinia-stage, however, that the differences are most marked, and for convenience may be shown in tabular form:—

	<i>P. conglomerata.</i>	<i>P. erectititis.</i>
Length of teleutospore	24.52 μ	36.63 μ .
Breadth ,,	14.26 μ	15.25 μ . (agree).
Apex ,,	{ surmounted by pale or colour- less papilla..... }	
		none.
Length of pedicel	{ short or moder- ately long	
		{ long.
Persistence ,,	very deciduous ...	decidedly persistent
Thickness ,,	very slender	moderately stout.
Colour ,,	hyaline	often yellow tint.

While a solitary character, such as the relative length of the stalk, or its persistence, would not justify specific rank, still the aggregate of relatively fixed characters, such as the apical papilla, the length and persistence of the stalk, form specific distinctions.

Finally, Dr. P. Dietel gives critical notes on all Puccinias occurring on *Senecio* and allied Compositæ in his paper on "*Puccinia conglomerata* und die auf *Senecio* und einigen verwandten Compositæ vorkommenden Puccinien."

^{*} He remarks there that recent writers have placed many different species in *P. conglomerata* and considers that *P. senecionis*, Lib., and *P. expansa*,

^{*} Hedwigia. Bd. xxx. 291 (1891).

Link, should be raised to specific rank. The Puccinias which he enumerates as occurring on *Senecio* are:—*P. conglomerata*, *P. senecionis*, *P. expansa* and *P. uralensis*; *P. tranzschelii* is also given, but it is now regarded as a variety of *P. conglomerata*. In *P. uralensis** the sori are hypophyllous, the teleutospores are much shorter ($36\text{--}43\ \mu$), and no aecidiospores are known, so that the distinctness of this species is still maintained. When the proper season comes round, infection experiments will be carried out mutually on *Senecio vulgaris* and *Erechtites quadridentata*.

TRIMORPHIC TELEUTOSPORES.

There are three forms of teleutospores in this species, as already stated—normal or uniseptate, aseptate and biseptate.

A similar case was recorded by W. B. Grove† in *Puccinia betonicae*, DC., belonging also to the *Pucciniopsis*, in which he found one-celled, two-celled and three-celled teleutospores. Since then several similar cases have been brought to light, and even four-celled spores have been observed in *Puccinia graminis*, Pers. In *Puccinia saccardoi*, Ludw., an Australian species on *Goodenia geniculata*, Dr. Ludwig‡ records the occurrence, among the normal teleutospores, of unicellular and tricellular spores, sometimes of enormous size, and occasionally singular horn-like branching spores, resembling those of *Phragmidium obtusum*. The whole subject is very fully and ably discussed by Dr. P. Dietel in his paper on “Beiträge zur Morphologie und Biologie des Uredineen.”§ The one-celled spores are commonly known as mesospores, and various views are held as to their meaning. Winter|| regards them simply as unicellular teleutospores and Sorauer¶ considers them as transition forms between uredospores

* Zeitsch. f. Pflanzk. Vol. ii. Pt. 2, 104 (1892).

† Gardener's Chronicle, Vol. xxiv. p. 180 (1885).

‡ Hedw. xxviii. pp. 362, 363 (1890).

§ Bot. Centralb. Vol. xxxii. (1887).

|| Die Pilze, Vol. i. p. 133 (1884).

¶ Pflanzenkrk. Vol. ii. p. 213 (1886).

and teleutospores, but on this view they ought to be more general and not confined to individual species.

P. Magnus* considers, on the other hand, that the uredospores have developed out of teleutospores on account of their better adaptation for germination and dissemination, and that those species which have no uredospores never acquired the property of forming them.

Dr. Plowright† considers them as morphologically analogous to the teleutospores of *Uromyces*, somewhat similar to the view of Tulasne,‡ who regards them as reduced teleutospores, the reduction being brought about by the abortion of the lower cell and thus the genus *Uromyces*, characterised by such spores, is to be considered a degraded form of *Puccinia*. There are other considerations, however, such as the nature of the host-plants, which would seem to point to the *Uromyces* as being rudimentary and not reduced forms of *Puccinia*.

In *Puccini pruni*, Pers., the two cells of the teleutospores readily separate and the lower cell is often imperfectly developed, so that the connection between *Uromyces* and *Puccinia* seems to be shown here. In fact, it would appear that even the eminent mycologist Dr. Cooke was misled by this resemblance when he named this very species, sent from Australia on peach and almond leaves, as *Uromyces amygdali*. And if this relationship is accepted, then the term mesospore, as indicating a transition-form between two other kinds of spore, is inappropriate, as it is really between the two genera.

Just as the unicellular or *Uromyces*-like spore links the *Puccinia* on to lower but not necessarily earlier forms, so the multicellular spore foreshadows the more advanced forms of the Uredines, such genera as *Triphragmium* in which the teleutospore is normally three-celled, and *Phragmidium*, in which it may consist of from three to ten superimposed cells. And thus close

* Ber. Deutsch. Bot. Gesell. ix. (1891).

† Brit. Ured. and Ustilag. p. 39 (1889).

‡ Ann. Sci. Nat. 4 Ser. Vol. ii. p. 145 (1854).

and constant observation of the exceptional forms of spores, just as the methodical investigation of exceptional forms of plants or animals may throw light upon the origin of certain phases of life and show that what is abnormal and exceptional at one stage and under certain surroundings, may become the normal under different conditions of existence.

EXPLANATION OF PLATES.

Puccinia on Groundsel.

(All figures except figs. 7 and 10 magnified 600 diameters.)

Plate XXXIV.

- Fig. 1.—Various shapes and sizes of aecidiospore.
Fig. 2.—Various forms of teleutospore.
Fig. 3.—Group of teleutospores.

Plate XXXV.

- Fig. 4.—Unicellular spores.
Fig. 5.—Three-celled teleutospore.
Fig. 6.—Aecidiospores.
Fig. 7.—Teleutospores ($\times 115$).

Plate XXXVI.

- Fig. 8.—Teleutospores.
Fig. 9.—Group of teleutospores.
Fig. 10.—Unicellular spore: the same ($\times 115$).
Fig. 11.—Tricellular spores.

CATALOGUE OF THE DESCRIBED COLEOPTERA OF AUSTRALIA. SUPPLEMENT, PART I. CICINDE- LIDÆ AND CARABIDÆ.

BY GEORGE MASTERS.

Issued separately as a Supplement to the Part.

ON A NEW SPECIES OF ELÆOCARPUS FROM
NORTHERN NEW SOUTH WALES.

By J. H. MAIDEN, F.L.S., AND R. T. BAKER, F.L.S.

ELÆOCARPUS BAEUERLENI, sp.nov.

(Plate XXXVII.)

A large tree (height 80-100 feet, and a trunk diameter of 2-3 feet as seen), the branchlets silky hairy or hoary pubescent, the young leaves very hairy.

Leaves or petioles usually $2-2\frac{1}{2}$ inches long, lanceolate to elliptical-lanceolate, acuminate, rounded at the base, scarcely shining above, up to 6 inches long, 1 inch broad, crenate, reticulations distinct on both sides, but more marked on the underside, slightly paler and glabrous underneath, but more or less silky hairy above, the young foliage densely so, occasionally foveolate.

Petiole silky pubescent, channelled above, slightly thickened at the two extremities.

Racemes terminal and over 5 inches long in specimens examined, silky pubescent, many-flowered.

Bracts *persistent*, silky pubescent, spathe-like, 3 to 4 lines long.

Pedicels 4-5 lines long.

Sepals silky pubescent, subtriangular, 2 to 3 lines long, valvate, with a prominent mid-rib on the inner surface.

Petals with a few scattered hairs or glabrous on the back, ciliate and very silky hairy on the inside especially towards the base divided into 16-20 acute equal lobes, mostly united into fours.

Stamens numerous (30), silky pubescent within the glandular disk.

Anthers linear, tipped with a subulate appendage. Filaments short.

Ovary glabrous, style subulate, 2-celled, with 2 ovules in each cell.

Drupe ovoid, 3 to 4 lines long, green, the putamen rugose.

Albumen not ruminant.

The affinities of this species apparently lie between *E. sericopetalus*, F.v.M., and *E. ruminatus*, F.v.M. Briefly, its relative position may be shown thus:—

E. sericopetalus.—Leaves $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long, glabrous, not foveolate, slightly crenate. Stamens 40-50; silky petals minutely denticulate.

E. Baeuerleni, sp.nov.—Leaves 3 to 5 inches long, 1 inch broad, lanceolate, much *reticulate*, acuminate crenate, occasionally foveolate. Stamens 30; petals lobed, bracts persistent. Fruit ovoid.

E. ruminatus.—Leaves 2 to 4 inches long, $1\frac{1}{2}$ inch broad, shining on both sides, petioles glabrous, shortly acuminate, pinnate-veined. Stamens 20-25. Fruit globular.

Hab.—Tengoggin (Chincogan) Mountain, Mullumbimby, Brunswick River, N.S.W.

This species is dedicated in honour of Mr. William Baeuerlen, botanical collector to the Technological Museum, Sydney, who first obtained it.

EXPLANATION OF PLATE.

Fig. 1.—Twig of plant showing foliage.

Fig. 2.—Flowering twig.

Fig. 3.—Bud.

Fig. 4.—Flower.

Fig. 5.—Section of flower.

Fig. 6.—Sepal.

Fig. 7.—Petal.

Fig. 8.—Stamen.

Fig. 9.—Pistil and glandular ring.

Fig. 10.—Drupe.

Fig. 11.—Putamen.

NEW SPECIES OF CONE FROM THE SOLOMON ISLANDS.

BY J. BRAZIER, F.L.S., C.M.Z.S.

CONUS WATERHOUSEÆ, sp.nov.

Shell somewhat solid, oblong, coronated; spire slightly raised, apex obtuse; whorls 8, having white nodes, the interspaces with dark brown spots, spirally sulcated with 6 rather narrow and deep grooves, having 2 closer together near the base showing faint little punctures like a thimble; colour yellowish-brown with whitish longitudinal flexuous streaks or blotches; columellar base very dark brown mingled with white; lip straight, whitish, interior of the aperture dark violet.

Long. 30; diam. maj. 15; aperture, 25 mm.

Hab.—Solomon Islands (Mrs. G. J. Waterhouse).

This very pretty Cone came from the Solomon Islands, but the exact island is not known. It has been in Mrs. Waterhouse's collection for the last twelve months. The specimen is in a good state of preservation; the spiral sulcations visible a little below the crown are very fine, and those near the base are deeply engraved, showing minute punctures or pits like those on a thimble; the colour markings are also peculiar, being of a yellowish-brown with whitish longitudinal flexuous streaks.

The only specimen I have at present seen has been lent me for description by Mrs. G. J. Waterhouse, after whom I have the pleasure of naming the species.

The type is now in the collection of Mrs. Agnes Kenyon, of Richmond, Victoria.

NOTES AND EXHIBITS.

Mr. Brazier exhibited a fine specimen of the ringed snake (*Vermicella annulata*) found under a large stone at the foot of the Waverley cemetery by Mr. Worth.

Mr. Brazier also exhibited a specimen of *Cardium vertebratum*, Jonas, from Keppel Bay, N. Queensland, and he contributed a Note on the geographical distribution of the species.

Mr. A. H. Lucas exhibited specimens of Honey Ants (*Camponotus inflatus*), and Lizards collected by Prof. Baldwin Spencer in Central Australia, during the breeding season of 1895, comprising both sexes of *Amphibolurus pictus*, *A. maculatus*, and *A. reticulatus*, showing the sexual colouring; *Moloch horridus* (♀). Also specimens of *Egernia stokesii* and *E. depressa*, the latter from Coolgardie.

Mr. Steel called attention to a recent interesting paper by Mr. T. W. Hogg, on the immunity of some low forms of life from lead-poisoning (Journ. Soc. Chem. Industry, 1895, p. 344). The presence of 1.5-2.5 per cent. of lead, calculated as PbO, in an average dried sample, was found not to militate against the occupation of the waste bark heap of the Elswick Lead Works by various organisms, including earthworms.

Mr. Froggatt showed, in illustration of his paper, spirit specimens of a number of Termites, photographs of remarkable termittaria, portions of nests, and specimens of timbers variously attacked.

Mr. Maiden exhibited specimens of the new *Elæocarpus* described by Mr. Baker and himself.

Mr. Pedley showed a highly ornamented hielaman or aboriginal shield recently received from the Narran River, N.S.W.

Mr. North exhibited a series of specimens of *Zosterops cerulescens*, and pointed out the seasonal variations in the plumage of this species. *Z. cerulescens* of Latham, (*Z. dorsalis*, Gould,

Birds of Australia, Vol. iv. pl. 81), with the deep tawny-buff flanks and the grey throat shows the autumn and winter attire, and *Z. (Dacnis) westernensis*, Quoy and Gaimard (Voyage de l'Astrolabe, T. i. p. 216, and Atlas, plate 11, fig. 4) with the bright olive-yellow throat and very pale tawny-brown flanks, the spring and summer livery. Among the specimens exhibited by Mr. North and bearing out his statements was one captured in his garden at Ashfield on the 26th inst., which shows a transition from the winter to the spring plumage, the grey throat being faintly washed with olive-yellow, and the flanks nearly as pale as specimens obtained in the summer. *Z. westernensis*, Quoy and Gaim., and other writers must therefore become a synonym of the older name *Z. caerulescens*, of Latham.

WEDNESDAY, AUGUST 28TH, 1895.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, August 28th, 1895.

Mr. Cecil W. Darley in the Chair.

DONATIONS.

Hooker's *Icones Plantarum*. Fourth Series. Vol. iv. Part 4 (June, 1895). *From the Bentham Trustees.*

Royal Microscopical Society—Journal, 1895, Part 3 (June). *From the Society.*

Société d' Horticulture du Doubs, Besançon—n.s. No. 54 (June, 1895). *From the Society.*

L'Académie Impériale des Sciences de St. Pétersbourg. v^o Série. T. ii. Nos. 3-4 (March-April, 1895). *From the Academy,*

Zoological Society, London—Abstract, June 18th, 1895. *From the Society.*

K.K. Zoologisch-botanische Gesellschaft in Wien—Verhandlungen. xlv. Bd. (1895), 5 Heft. *From the Society.*

Zoologischer Anzeiger. xviii. Jahrg. Nos. 478-479 (June-July, 1895). *From the Editor.*

College of Science, Imperial University, Japan—Journal. Vol. vii. Part 5 (1895). *From the Director.*

Société des Naturalistes de la Nouvelle Russie—Mémoires. Tome xix. Parts 1-2 (1894-95). *From the Society.*

Agricultural Gazette of N.S. Wales. Vol. vi. (1895), Part 7 (July). *From the Hon. the Minister for Mines and Agriculture.*

Perak Government Gazette. Vol. viii. (1895), Nos. 18-19. *From the Government Secretary.*

Department of Mines, Victoria—Annual Report of the Secretary for the year 1894. *From the Department.*

American Museum of Natural History—Bulletin. Vol. vii. (1895), Sigs. 13-15 (pp. 193-256). *From the Museum.*

Johns Hopkins University Circulars. Vol. xiv. No. 120 (July, 1895). *From the University.*

Indian Museum, Calcutta—"Materials for a Carcinological Fauna of India." No. 1—The *Brachyura Oxyrhyncha*. By A. Alcock, M.B., C.M.Z.S.: Figures and Descriptions of Nine Species of *Squillidae* from the Collection in the Indian Museum. By the late James Wood-Mason. 4to. (1895). *From the Museum.*

Pamphlet entitled "Notes on the Hydatid Disease in New South Wales." By G. L. Mullins, M.A., M.D. *From the Author.*

Victorian Naturalist. Vol. xii. No. 4 (July, 1895). *From the Field Naturalists' Club of Victoria.*

Société Royale des Sciences, Upsal—Nova Acta. Seriei iii. Vol. xv. Fasc. 2 (1895). *From the Society.*

Zoologische Station zu Neapel—Mittheilungen. xii. Bd. 1 Heft (1895). *From the Zoological Station.*

American Naturalist. Vol. xxix. No. 343 (July, 1895). *From the Editors.*

Geological Survey of Canada—Annual Report, 1892-93. New Series. Vol. vi. *From the Director.*

Société Hollandaise des Sciences à Harlem—Archives Néerlandaises. T. xxix. 2^{me} Liv. (1895). *From the Society.*

Société Royale Linnéenne de Bruxelles—Bulletin. xx^{me} Année No. 8 (June-July, 1895). *From the Society.*

University of Melbourne—Calendar for 1896. *From the University.*

Linnean Society of London—Proceedings. November, 1893-June, 1894: List of Fellows, &c., 1894-95. *From the Society.*

Société Royale de Géographie d' Anvers—Bulletin. T. xx. 1^{er} Fasc. (1895). *From the Society.*

Eight Conchological Pamphlets. By Edgar A. Smith, F.Z.S. *From the Author.*

Australasian Journal of Pharmacy. Vol. x. No. 116 (August, 1895). *From the Editor.*

Gordon College Museum, Geelong—The Wombat. Vol. i. No. 1 (Aug. 1895). *From the Museum.*

Pamphlet (from the Ibis, July, 1895). *From the Author, A. J. North, Esq., F.L.S.*

ON THE HOMOLOGY OF THE PALATINE PROCESS OF THE MAMMALIAN PREMAXILLARY.

BY R. BROOM, M.B., C.M., B.Sc.

In typical mammals the premaxillary bone may be divided into two more or less well marked parts. There is the anterior and outer part bearing the incisor teeth and forming the outer wall and floor of the nasal cavity at its anterior part, and there is generally an elongated delicate process of bone passing backwards into the palatine region—the palatine process of the premaxillary. Throughout the Mammalia the tooth-bearing part of the premaxillary varies comparatively little; but in the palatine process even in closely allied forms we have the most striking variations. Among Marsupials, for example, in the genus *Trichosurus* the palatine process is exceedingly long, while in the closely allied *Phascolarctus* it is only slightly developed.

Opinion seems to be considerably divided as to whether the premaxillary is a single structure, or whether it is in reality composed of two distinct elements. Albrecht,* Sutton†, and Parker‡ have shown that the palatine process may be distinct in origin from the body of the premaxillary through becoming early united with it, and Howes§ states as the result of a special

* P. Albrecht, "Sur la Fente maxillaire double sousmuqueuse et les 4 os intermaxillaires de l'Ornithorhynque adulte normale." (Bruxelles, 1883).

P. Albrecht, "Die morphol. Bedeutung der seitlichen Kieferspalte, &c." Zool. Anzeiger, 1879.

† J. B. Sutton, "Observations on the Parasphenoid, the Vomer and the Palato-pterygoid Arcade." Proc. Zool. Soc. 1884, p. 566

‡ W. K. Parker, "On the Structure and Development of the Skull in the Mammalia," Pt. ii. Edentata; Pt. iii. Insectivora. Phil. Trans. Roy. Soc. Lond. 1885.

§ G. B. Howes, "On the Probable Existence of a Jacobson's Organ among the *Crocodylia*, &c." Proc. Zool. Soc. 1891.

investigation by Mr. R. H. Burne that the palatine process is distinct from the premaxillary in an embryo Rabbit as large as 8 cm. Furthermore, Albrecht and Sutton have both maintained that the palatine process is a distinct element from the premaxillary proper, though owing to their evidence being largely pathological their views have not been generally accepted. Sutton holds that the palatine process is the homologue of the "vomer" of the *Ichthyopsida*, and that the mammalian vomer is represented by the parasphenoid in the lower forms. Whether he is correct or not in his Ichthyopsidian homologies I am not in a position to definitely determine; but I think there is very strong evidence in favour of the homology of the mammalian palatine process of the premaxillary with the so-called "vomer" of at least the lizard and snake, and in the present paper I shall bring forward a few facts from Comparative Anatomy and Embryology in favour of such a view.

For some time I have been engaged in the study of the comparative anatomy of Jacobson's Organ, and having studied the anterior nasal region of a very large number of mammals and reptiles by means of microscopic sections, I have come across a number of interesting facts in connection with the present subject.

In mammals the organs of Jacobson, as is well known, are supported by the "recurrent cartilages"—developments of the trabecular cornua, and as the cartilages are almost invariably developed to a similar degree to the organs, the close connection between the two is manifest. Furthermore, the cartilaginous framework of each organ rests on a bony support curved to fit the cartilage, and which is almost invariably ankylosed to the premaxillary forming its palatine process. When the organ of Jacobson is well developed and much elongated, its bony support is correspondingly long, while when the organ is rudimentary the palatine process is short or absent. So that not only is there a close connection existing between the organ and the cartilage, but also an intimate association between the cartilage and the supporting bone.

An examination of the early development of the parts shows that this close connection is not accidental, but that the supporting bone is developed as a splint to the cartilage. If a mammary fetus of the common Phalanger (*Trichosurus vulpecula*) 18 mm. in length be examined, it will be found that the body of the premaxillary is already fairly well ossified. The recurrent cartilages will be seen in section as two plates, slightly diverging below, lying on either side of the middle line below the base of the cartilaginous nasal septum. About the middle of the inner side of each recurrent cartilage and close to it is a tract of active cells, in the centre of which is a very delicate spicule of bone. This spicule, it must be admitted, is directly connected with the premaxillary, though as the tract of bone-producing cells in connection with the recurrent cartilage is practically similar to that which a little posteriorly lies around the base of the septum nasi and gives rise to the vomer, it is highly probable that there is a distinct osteogenetic tract in connection with the recurrent cartilage, and that owing to the early development of the premaxillary it is prematurely ossified by invasion from that bone. In *Perameles* and *Dasypus* the recurrent cartilage tract is similarly ossified by a bony process from the premaxillary. In many of the higher mammals (e.g., *Erinaceus*, *Tatusia*) it would appear that the ossification in connection with the recurrent cartilage maintains for some time its independent existence, though uniting later with the premaxillary to form its palatine process. In a few mammals (e.g., *Ornithorhynchus* and *Miniopterus*) the ossification remains as a distinct bone throughout life.

Prof. Kitchen Parker,* who has done more than anyone else to elucidate the development of the skull, does not seem to have arrived at any certain conclusions with regard to the nature of the palatine process of the premaxillary. His researches show that he discovered supporting the cartilages of Jacobson a distinct bone which he called the "anterior paired vomer," but it is probable that, as Howes has pointed out, in trying to draw a

* *Loc. cit.*

distinction between this bone and the palatine process of the premaxillary he has involved himself in contradiction. In his beautiful sections of the head of the fetal *Tatusia* he shows the supporting bones of Jacobson's cartilages, and in his description of section 7, says:—"The cartilages [protecting Jacobson's organs] themselves have an osseous counterpart protecting them on the inner side and having their shape and direction; these are the anterior paired vomers (v'), bones well known for their large development in the *Ophidia* and *Lacertilia*" He further recognises that these are not parts of the true vomer, and evidently considers them as quite distinct from the premaxillary. In his description of the head of the young *Erinaceus*, he further refers to the intimate association of the recurrent cartilages and their supporting bones or anterior paired vomers. In referring to the recurrent cartilages as seen in the dissected skull of the young embryo, he says:—"Each leafy part is supported by a bone the form of which it dominates, so that each tract is also hollow on the face that looks towards the curved inner edge of the cartilage; it lies on the inside, back to back to its fellow: these are the front paired vomers, and answer to the paired vomers of the Snake and Lizard among the Reptiles." These bones which he calls "anterior paired vomers" are almost without doubt the parts which, becoming anchylosed with the premaxillaries, form their palatine processes. Parker, however, seems to consider that there are palatine processes in addition to the anterior vomers, but as the cartilages of Jacobson at their anterior part are in contact with the body of the premaxillary there is really no space for a palatine process distinct from the ossification in connection with Jacobson's cartilage, and if in any form there appears to be a palatine process in addition to an anterior vomer it is probably due to the anterior portion of ossific tract of Jacobson's cartilage becoming ossified by invasion from the premaxillary.

A study of the comparative anatomy of the prenasal region gives very strong confirmatory evidence that the bone supporting the cartilage of Jacobson is not morphologically a part of the premaxillary, though generally anchylosed with it.

There is one interesting group of mammals—the *Cheiroptera*—in which the condition of parts has not, I think, been very carefully observed, and from which we find considerable assistance in the solution of the present problem. In the insectivorous bat common in this district (*Miniopterus Schreibersii*, Natt.) the organ of Jacobson is well developed, but is unlike that of the typical mammal in being unusually short compared with its breadth. The premaxillæ are moderately well developed, though they do not quite meet in the middle line, but they do not possess even a trace of palatine process. The cartilages of Jacobson are supported on the inner side by a small median bone which is quite unconnected with either the premaxillæ in front or the vomer behind. It is situated immediately in front of the anterior end of the vomer and clearly belongs to the same class of bones as the vomer proper, though instead of being closely related to the septal cartilage, it supports the cartilages of Jacobson throughout almost their whole length. In front where the capsules are moderately close together, a transverse section reveals two bony plates supporting them ankylosed in their lower halves. Posteriorly the capsules are considerably apart, and the bone is here found as a flat plate stretching from the one to the other.

In the common Australian flying-fox (*Pteropus poliocephalus*, Tem.) the condition is very different, but peculiarly interesting. The premaxillæ are as well developed as in the *Carnivora*, though they do not quite meet in the middle line. The organ of Jacobson as apparently in most insectivorous bats is here entirely absent, though the recurrent cartilages are fairly well developed as a pair of almost vertical plates. There is, however, no distinct supporting bone as in *Miniopterus*, nor a trace of palatine processes from the premaxillaries; but, on the other hand, the vomer is well developed, and from it a process of bone passes forward into the region corresponding to that occupied by the palatine process in ordinary mammals, though, unlike the palatine process, it only supports the posterior part of the cartilage. Whether in the fetal condition this process is ever distinct, I have not had the opportunity of ascertaining.

In man a somewhat similar condition exists, though he differs from *Pteropus* in having a rudimentary organ of Jacobson. Here there is no palatine process to the premaxillary, and the rudimentary recurrent cartilage—the plough-share cartilage of Huscke—is not supported by a distinct bone; but in a human fœtus of 10 weeks I have found on the inner side a small tract of osteogenetic cells very similar in position to those in *Trichosurus*, but here ossified by an invasion from the vomer.

In *Ornithorhynchus* we find still further evidence of the vomerine nature of the bony support of Jacobson's cartilage. Here in the adult we find the capsule of Jacobson's organ supported by the median "dumbbell-shaped bone"—a structure which bears a very marked resemblance to the little median bone lying between the organs in the bat. Since its first discovery this peculiar dumbbell-shaped bone has been the subject of very considerable discussion as to its true nature. Three different opinions have been expressed with regard to it, but as one of them—that homologising it with the prenasal bone of the pig—has been abandoned by its author, and is known to be founded on a misconception, only the other two need be discussed. The view which has received almost universal support—that of Rudolphi, Meckel and Owen—is that it is the inner part of the premaxillary and the *homologue* of the palatine process of the premaxillary in the higher mammals. In more recent times Albrecht,* Turner,† Flower‡ and Symington§ have advocated the same view, and have adduced arguments which practically amount to conclusive proof of the correctness of their position. The other view which has been expressed as to its nature is that recently

* *Loc. cit.*

† W. Turner, "The Dumbbell-shaped Bone in the palate of the *Ornithorhynchus* compared with the Prenasal Bone in the Pig." *Journ. Anat. and Phys.* Vol. xix.

‡ W. H. Flower, "Osteology of the Mammalia." 3rd Ed. Lond. 1885.

§ J. Symington, "The Nose, the Organ of Jacobson, and the dumbbell-shaped bone in *Ornithorhynchus*." *Proc. Zool. Soc.* 1891.

advocated by Wilson.* In his paper published by this Society he gives a very accurate and minute description of the bone and its relations, and gives reasons for considering the bone to be a true vomerine element and no part of the premaxillary. His main arguments may be briefly summarised as follows:—(1) That as the posterior part of the palatine plate of the dumbbell bone rests on the “cartilage of the nasal floor” it is on a higher plane than the maxillary palate; (2) that the vertical part is prolonged backwards for a considerable distance dorsad of the maxillary plane, and “that a bone which is so prolonged backwards on a higher plane than the maxillary palate cannot be regarded as developed in the same morphological plane with it”; and (3) that the posterior spur is separated from the maxillary palate by a peculiar hiatus. These arguments afford practically conclusive proof that the dumbbell-shaped bone belongs to the vomerine category and is no part of the premaxillary; and to Wilson thus belongs the credit of having first clearly recognised the vomerine nature of the bone. But on the other hand, while the above arguments show that the bone is not part of the premaxillary, they rather support than disprove its homology with the element usually called “palatine process of the premaxillary,” and Wilson himself recognises the weight of evidence in favour of this homology; and when once it becomes recognised that the palatine process of the premaxillary is itself a distinct vomerine element anchylosed or formed in connection with the premaxillary the difficulty of reconciling the two views at once disappears. W. N. Parker,† in his recent paper on *Echidna*, gives a section of a young *Ornithorhynchus* skull which shows the dumbbell-shaped bone developing as bony splints to the cartilages of Jacobson in exactly the same manner as Kitchen Parker has

* J. T. Wilson, “Observations upon the Anatomy and Relations of the dumbbell-shaped bone in *Ornithorhynchus*, with a new theory of its homology, &c.” Proc. Linn. Soc. N.S.W. 1894.

† W. N. Parker, “On some points in the Structure of the Young of *Echidna aculeata*.” Proc. Zool. Soc. 1894.

figured his anterior paired vomers developing in *Erinaceus*; and the only difference in the mode of development of the palatine process of the premaxillary in the young marsupial is that in it the bony splint of Jacobson's cartilage is while developing united anteriorly to the premaxillary.

There is one other bone to which reference need be made in this connection—the so-called “vomer” of the lizard. Most anatomists have regarded this as the homologue of the mammalian vomer. Kitchen Parker, however, though generally referring to the large paired bones in the front of the palatal region in the acertilian skull as “vomers,” evidently later recognises their homology with the anterior paired vomers in *Erinaceus*, and not with the mammalian vomer proper, as will be seen from the passage already quoted. With this homology I entirely agree. It is universally admitted that the organ of Jacobson in the lizard is the true homologue of that in the mammal, and there can be as little doubt but that the cartilaginous supports, both being developments of the trabecular cornu, are also homologous, so that the homology of the bones developed as splints on the median sides of these cartilages in similar situations cannot well be denied. In lizards, moreover, the premaxillary has no palatine process, and the so-called vomer bears a similar relation to the premaxillary as does the palatine process in the mammal. In the snake this “vomer” passes up the septum nasi, and even slightly overlaps the capsules of Jacobson; but this is exactly what occurs in *Ornithorhynchus*, and to a less extent in some rodents.

It will thus be seen that there is a distinct osseous element developed as a splint on the median side of the cartilage of Jacobson, which in lizards and snakes like the organ of Jacobson itself is well developed and distinct, but which in mammals, probably owing to the great development of the premaxilla in connection with the well formed incisor teeth, usually becomes early ankylosed with that bone, and in many cases even developing in connection with it, forming its palatine process, only remaining distinct in a few forms such as *Ornithorhynchus* and *Miniopterus*. For this ossification which in different forms has

gone under a variety of designations, I would propose the name of Prevomer as more in harmony with the general terminology than "Anterior Vomer," and also as Kitchen Parker evidently regarded his "Anterior Paired Vomer" as an element quite distinct from the palatine process of the premaxillary and only exceptionally present in the mammalian skull.

The following table gives the chief synonyms and homologies of the Prevomer:—

- Prevomer (Broom) = Palatine process of premaxilla in mammalia generally.
 = Dumbbell-shaped bone, or Os paradoxum in *Ornithorhynchus*.
 = Anterior vomer, in *Ornithorhynchus* (Wilson).
 = Anterior paired vomer, in foetal *Insectivora*, &c. (Parker)
 = Prepalatine lobe of vomer, in *Caiman* (Howes)
 = Vomer, in *Lacertilia* and *Ophidia* (Owen, Parker, &c.)

Further research may extend the homology to the "vomer" in Amphibia and fishes, but this I have not had an opportunity of ascertaining.

In conclusion I must acknowledge my indebtedness to Prof. Wilson for various kindnesses; to Messrs. Etheridge and Waite of the Australian Museum for identifying for me the bat and flying-fox examined; and to my father, Mr. John Broom, for making abstracts of papers, not otherwise accessible to me.

THE SILURIAN TRILOBITES OF NEW SOUTH WALES,
WITH REFERENCES TO THOSE OF OTHER
PARTS OF AUSTRALIA.

BY R. ETHERIDGE, JUNR.—CURATOR OF THE AUSTRALIAN MUSEUM
—AND JOHN MITCHELL, PUBLIC SCHOOL, NARELLAN.

PART III.

The PHACOPIDÆ.

(Plates XXXVIII.-XL.)

The family of the Phacopidæ is one of the most important to be met with in our Lower Palæozoic rocks, both on account of the wide distribution of its members geographically—being met with in the Silurian rocks of both N.S. Wales, Victoria, and Tasmania—and their close connection with those of similar deposits in the Old World.

The literature of the family is very limited, and is confined to the description by Sir F. McCoy of species referred* by him to the following:—

1. *Odontochile caudatus*, Brün., sp.
2. *Portlockia fecundus*, Barr., sp.

and by Mr. A. F. Foerste† to—

3. *Phacops serratus*, Foerste.

The horizons yielding these fossils are:—

- a. Olive mudstones of Broadhurst's Creek, near Kilmore, Victoria—No. 1.
- b. Arenaceous beds of Yerring, Upper Yarra, Victoria—No. 2.
- c. Olive-brown mudstones of the Bowning District, N.S. Wales—No. 3.

* Prod. Pal. Vict. 1876, Dec. iii. pp. 13-16.

† Bull. Sci. Lab. Denison Univ. 1888, iii.

We do not notice incidental references to other localities, when unaccompanied by descriptions, nor catalogue names in the same category.

The Tasmanian forms are at present undescribed.

The Phacopidæ is represented throughout Australian Silurian rocks, so far as we can ascertain with certainty, by two genera only—*Phacops*, Emmrich, and *Hausmannia*, Hall and Clarke. During our researches we have not met with any Trilobites that could be referred to either of the following :—*Acaste*, Goldfuss; *Chasmops*, McCoy; *Pterygomotopus*, Schmidt; *Trimerocephalus*, McCoy; *Portlockia*, McCoy; *Cryphæus*, Green; *Coronura*, Hall and Clarke; *Odontocephalus*, Hall and Clarke; or *Corycephalus*, Hall and Clarke.

We imply a doubt because the subject of our Pl. xxxix. fig. 12, appears to foreshadow a third section or genus, but the material is too scanty to enable us to pass a definite opinion.

Genus PHACOPS, Emmrich, 1839.

Phacops in its restricted sense, following the researches of Salter* and Schmidt,† and to some extent of Barrande‡ also, omitting other minor characters, is distinguished from other members of the Phacopidæ chiefly by the presence of the two anterior pairs of glabella furrows, generally linear in character, and of which the first or anterior pair frequently consists of two branches. The fore part of the glabella, formed by the frontal and lateral lobes, is, as a whole, cut off from the neck segment by the intervention of a supplementary ring, termed by Barrande the “intercalary ring” (anneau intercalaire)§. Barrande used this feature as one of the chief distinguishing points between the only two genera recognised by him in the Bohemian Silurian rocks, *Phacops* and *Dalmania* (vel *Dalmanites*). This eminent author considered

* Mon. Brit. Sil. Trilobites, Pt. 1, pp. 13 and 14.

† Mém. Soc. Imp. Sci. St. Petersb. 1881, xxx. (7), No. 1.

‡ Syst. Sil. Bohême, 1852, i. p. 498.

§ Loc. cit. p. 505.

that *Phacops* possessed the three ordinary pairs of glabella furrows, whilst Salter viewed the first pair as consisting of two parts, a feature in which Schmidt seems to agree with him, i.e., Salter's first pair is equal to Barrande's first and second. The arguments for and against the respective views of these authors are too long to be introduced here, but looking at the matter dispassionately there appear to be good grounds for supporting the opinions of Salter and Schmidt.

The presence of the intercalary ring we regard as of very considerable importance in the limitation of *Phacops* proper. It is the "linear lobe" of Salter,* and the groove separating the ring from the glabella proper is the "maxillary furrow" of McCoy†. The intercalary ring is, in fact, formed by the confluence of the third pair of glabella furrows, with small circumscribed lobes at the outer ends. It appears to mark off a series of species, including *Phacops latifrons*, Bronn, the type of the genus, *P. cephalotes*, Corda, *P. fecundus*, Barr., and some others, from the remaining sections, sub-genera, or genera, whichever the reader prefers to regard them, usually associated under the broader name of *Phacops* of older writers. We therefore adopt *Phacops* as limited and defined more especially by Salter, and followed in many particulars by Schmidt. This restriction also has the advantage of comprising within it Emmrich's type of his genus, *P. latifrons*, Bronn.

As regards species, we have succeeded in establishing the presence of three in the Silurian rocks of N.S. Wales, viz.:—

Phacops Crossleii, nobis.

„ *latigenalis*, nobis.

„ *serratus*, Foerste.

And two in Victoria, viz.:—

Phacops Sweeti, nobis. (? *P. fecundus* McCoy, non Barr.)

„ *mansfieldensis*, nobis.

If, however, *P. fecundus*, McCoy, be distinct from our *P. Sweeti*, then three forms are known from Victoria.

* Mon. Brit. Sil. Trilobites, Pt. 1, p. 21.

† Prod. Pal. Vict. 1876, Dec. iii. p. 15.

PHACOPS CROSSLEII, *sp. nov.*

(Pl. XXXIX., figs. 9-11.)

Sp. Char.—*Body*—oblong-oval. *Head-shield or cephalon*—Semi-circular, rather flattened above, sides abruptly depressed; glabella large, subpentagonal, greatly contracted behind, highest between the eyes, very slightly arched in front, overhanging the front border, rounded so that taking for centre the middle point of the confluent basal pair of glabella furrows, the curve forms the arc of a circle with radius equal to the length between the point mentioned and its front, tolerably inflated, sides straight, inclined inwards at an angle of 60° , greatest width equal to length including neck ring, coarsely granulate; intercalary furrows distinct, deep (in casts) at sides and close to the neck furrow, with which they communicate, thus forming prominent basal lobes; second pair linear, feeble and falcate, and seem, in some specimens, to communicate with the basal pair, and with the axial grooves; first or frontal pair linear, faint and feeble, arising from the axial furrow at the front corners of the glabella, and traversing it in a very widely V-shaped manner, the inner portion being shortest and slightly falcate; frontal lobes very large, second pair cleaver-shaped, third pair suboblong, fourth pair nodular; neck furrow very distinct, continued across the side lobes with equal distinctness; and faintly along the inner edge of the border of the free cheeks to the front of the axial groove; neck ring robust, strongly arched, granulate, one large granule in the middle line; axial grooves very distinct, deep and wide; fixed cheeks small; genal lobes* moderately arched, granulate and separated from the palpebral lobes by distinct shallow furrows, which pass posteriorly round and under the eyes, giving relief to those organs. Eyes large, equal in length to half of the longitudinal length of the cheek, anteriorly scarcely reach the front

* That portion of the fixed cheek between the palpebral lobe and axial furrow and bounded posteriorly by the lateral extension of the neck furrow.

angles of the glabella, posteriorly in a line with the basal glabella furrows; curve of lentiferous face front to back semicordoid, apically inclined inward at an angle of about 50° ; lenses very convex, the normal number of vertical rows is seventeen, with five lenses in each, except the terminal rows at each end; the first row in front has usually three, the next four, then follow twelve rows of five lenses, their three posterior rows having four, three and two respectively, making a total of seventy-six lenses for each eye, which are separated by minute spaces, but no partitions are visible.

Thorax.—Square, sides almost perpendicular; axis distinct, sub-semicylindrical, about two-thirds as wide as the contour measurement of the pleuræ, ends of each segment nodular, posterior segments distinctly arched forward; pleuræ between axial furrow and fulcræ horizontal, then intensely deflected, forming almost perpendicular sides, extremities procurved and flattened; pleural furrows distinct on horizontal portions, gradually diminishing on the deflected parts and ceasing about midway between the fulcræ and extremities, making the front ridges distinctly triangular, posterior ridges very robust and continuous, with diminishing intensity to the rounded extremities, posterior edges of pleuræ traversed (in decorticated specimens) by a fine groove which shows most distinctly on the deflected portions, evidently marking the thickness of the test.

Pygidium.—Roughly semicircular, highly convex, anterior margin nearly straight; axis very prominent, composed of eight segments, the first and second segments very distinct, and strongly arched forward; each succeeding segment diminishes in distinctness so that the blunt terminal piece is hardly separable from the thickened border, and is half the width of the anterior portion; axial furrows moderately distinct; lateral lobes very tumid, sharply deflected, consisting of six or seven pleuræ, furrows of first pair like those of the thoracic pleuræ, each succeeding pair becoming fainter till the seventh is rarely discernible and do not reach the edges; sutures distinct; in decorticated specimens a distinct

smooth border is exposed bounded on outer edge by a linear furrow.

Obs.—This species in some respects resembles *P. fecundus*, Barr., with which we were inclined on first inspection to consider it to be identical. Closer examination, however, has revealed sufficient differences between them to justify us in separating it from that species.

In the first place, in our species the greatest length of the glabella, including the neck ring, equals its greatest width. In *P. fecundus* the glabella furrows are distinct on immature individuals, but rarely so on mature ones, which is just the opposite to the case in our species. Again, the eyes of the latter have, so far as we have been able to observe in all our numerous specimens, a constant number of seventeen vertical rows of lenses, and never more than five lenses in a row, except in rare cases where a rudimentary lens occurs at the top.

The lateral extension of the neck furrow around the edge of the border of the side lobes is not nearly so distinct in our species as in *P. fecundus*, Barr., and it ceases in front of the eye instead of joining the furrow passing round the frontal base of the glabella.

Between the thoraces of the two species there appears little difference, except that the thoracic test of ours seems to have been smoother, and the sides more perpendicular.

The pygidium of our species is more nearly semicircular, and its axis is not sunk between the side lobes, with an almost constant number of seven segments, and rarely if ever eight. The side lobes are divided into six or, doubtfully, seven pleuræ.

To sum up, our species is separated from *P. fecundus* by having a much smaller eye, the features of which remain constant in all mature individuals, a less distinct furrow separating the glabella in front from the rudimentary limb, by a smaller number of divisions in the axis and side lobes of the pygidium; and apparently a much thinner test, which was less distinctly granulated on the thorax and pygidium.

P. Crossleyi agrees very closely with *P. rana*, Hall, from which it differs in the number of lenses in, and position of the eye; and the absence in the latter of lateral furrows on the glabella.

From our *P. latigenalis* it is separated by the greater proportional length and height of the eyes, and by the constant linear character of the glabella furrows, by the smaller space between the bottom of the eye and the cheek border, the more upright glabella cheeks, and wider axial furrows between the glabella and fixed cheeks. The glabella is also less expanded in front transversely. The pygidium has a more semicircular contour, and its axis differs from *P. latigenalis* by contracting more gradually from front to back, and in not being sunk between the side lobes. The head shields of young specimens of the two species do not show the differences in so marked a manner, nor are the thoraces of the two separable from each other in a decorticated state; but when the mature specimens of each species are compared the differences noted above are evident.

Such a variation may be expected even were *P. latigenalis* the progenitor of this species, for they are separated by 3000 ft. to 4000 ft. of strata, chiefly consisting of mudstone shales, which must represent a long geological period.

From *P. fecundus*, McCoy, it is at once separated by the very much smaller eye, greater posterior contraction of the glabella, deeper and wider axial furrows of the cephalon, and by some differences in the pygidium. *P. Crossleyi* is a smaller species than either of the others described in the present paper, or *P. fecundus*, Barr., none of our specimens exceeding two inches in length.

It has been specifically named after Mr. R. Crossley, of Whitefield, Bowning, in recognition of much valuable assistance rendered by him to one of us in the collection of specimens.

Loc. and Horizon.—Bowing Village, Co. Harden. Upper Trilobite Bed, Bowning Series (= *Hume Beds*, Jenkins, and *Lass Beds*, David)—? Wenlock. *Coll.* Mitchell.

PHACOPS LATIGENALIS, *sp. nov.*

(Pl. xxxix., figs. 3-6; Pl. xl., figs. 2-6 and 9.)

Sp. Char.—*Body*.—Oblong ovate. *Head-shield or cephalon*.—Subsemicircular, but a little wider than twice the length. Glabella, including neck ring, wider than long, the proportion being about as 4-3, highly tumid in large specimens, expanded transversely, slightly overhanging in front, and separated from the rudimentary limb by a fairly distinct groove which communicates with the axial furrows, strongly granulate, granules subconical, and nearly uniform in size, sometimes coalescing and forming ridges or wrinkles; glabella grooves very distinct, deep, and in large specimens the first and second pair are overhung by frontal and second lobes very decidedly, intercalary groove wide; second pair gently curved or falcate, and in mature decorticated specimens seem to communicate with the axial furrows; first pair widely V-shaped, the inner branch being subfalcate, passing into the axial furrows at the front angles of the glabella; frontal lobes very large, occupying more than two-thirds of the glabella; second pair small, subdeltiform; third pair small and suboblong; intercalary ring nodular; axial grooves deep; neck furrow very deep and continuing with equal distinctness across the side lobes to the inner edges of the borders of the free cheeks and thence faintly to the front of the eye, where it is interrupted by the lobe on which the eye rests; neck ring intensely arched, rather narrow, ends nodular; fixed cheeks small; genal lobes deltiform, arched, granular; palpebral lobes lunate, separated from genal lobes by shallow but distinct furrows, which continue posteriorly round and under the eyes, adding to the prominence of those organs; anteriorly they pass into the axial grooves; free cheeks practically smooth, coalesced, extended towards the genal angles, border wide, thick, genal angles flattened, forming large triangular facets on which the first pleuræ imbricate. Eyes half as long as greatest length of cheeks, slightly overhanging, subsemicardiod or lunate; perpendicular height small compared with that of most species of the

genus; the number of vertical rows of lenses in each eye is seventeen, and the greatest number of lenses in a row is five, and this number only in a few rows, the other rows having four, three, and two; lenses prominent and not closely packed, cups proportionately small, attachment processes visible, cornea present as partitions between the oblique rows; as far as we have been able to observe, the number of lenses in each eye is 73.

Thorax.—Length about equal to width; axis very prominent and semitubular, width throughout almost the same, and equal to that of the side lobes; fore rings arched forward, outer ends strongly nodular; lateral lobes horizontal between the axial grooves and the fulcræ; at fulcræ deflected at an angle of 65° - 70° , width of horizontal portion about two-thirds that of the deflected portion; pleural furrows deep, vanishing about midway between fulcræ ends in decorticated specimens; pleuræ recurved, facets large and procurved, anterior ridges triangular, posterior ones robust and merging into the facets.

Pygidium.—About twice as wide as long, subtriangular, with a slight transverse central arch; axis conspicuous, slightly depressed between the side lobes, eight rings present; anterior ones intensely arched with a forward inclination, posteriorly diminishing in this respect until the terminal piece almost merges into the border, posterior width a little less than half of the anterior width; six to seven very distinct pleuræ on each side, very convex, steeply depressed at the sides; pleural furrows deep and wide, terminating at the borders; interpleural sutures distinct; axial furrows distinct; the whole surface of the decorticated specimens shows indication of strong granulation.

Obs.—Owing to the great tumidity and rugosity of the glabella, the deep slit-like character of the glabella grooves (overhung in the case of the first pair by the frontal lobes) in the large specimens of this form, we were disposed to make a separate species of this type; but after an inspection of a large number of specimens we conclude that this greater tumidity, &c., results from age.

We have not seen a complete thorax nor the latter with a pygidium attached.

The largest cephalon that has come under observation indicates a length of three and a half to four inches for the whole body, therefore rivalling in size any of the *P. fecundus* or *P. latifrons* groups. From *P. fecundus*, Barr., it is clearly separated by the greater frontal expansion, and tumidity of the glabella, by the very distinct and deep glabella grooves, and the much smaller number of eyelets in the eyes. The presence of the glabella furrows at once separates it from such species as *P. latifrons* and *P. rana*. The above characters also separate it from our *P. Crossleii* and *P. Sweeti*, except that the eyes of *P. latigenalis* and *P. Crossleii* do not differ very widely.

From *P. fecundus*, McCoy, (*non* Barr.), it is also distinguishable by the points above enumerated.

To sum up, the distinguishing features of this species are its very tumid or inflated and rugose glabella, deep overhung glabella furrows, small number of lenses in the vertical rows of the eyes, which are supported on a distinct pedestal, and the wide cheeks.

Loc. and Horizon.—Bowning, and Limestone Creek, near Bowning, Co. Harden. Middle Trilobite Bed, Bowning Series—? Wenlock. *Coll.*—Mitchell; and Geol. and Mining Mus., Dept. of Mines, Sydney.

PHACOPS SERRATUS, *Foerste*:

(Pl. xxxix., figs. 7 and 8; Pl. xl., figs. 7 and 8 and 11.)

P. serratus, Foerste, Bull. Sci. Lab. Denison Univ. 1888. iii.

Sp. Char.—*Body*—Oblongoval. *Head-shield or cephalon*.—Nearly semicircular, a little wider than twice the length, highly tumid. Glabella, including neck ring, as wide as long, overhanging and tumid in front, very convex, surface highly granulate with fairly large and uniform granules, separated from rudimentary limb in front by a very faint groove; sides straight, converging at angle of 60°; frontal furrows linear, widely V-shaped, outer branches straight and passing into the axial grooves at the frontal angles, inner branches subfalcate, medial pair linear, subfalcate, and apparently not joining the axial furrows; frontal lobe large and subpentagonal, second lobes subtrapezoidal, small, third pair suboblong

and small; intercalary ring nodular; axial grooves deep and wide; neck furrow distinct, and continued across the lateral lobes very distinctly; neck ring robust and bearing centrally a spine of varying size, corresponding with the thoracic axial spines, bases nodular; lateral lobes small, triangular, tumid, borders thickened, their measurement from genal angles to the front of the axial grooves equal to half the front width of the glabella; posterior facets strongly ridged; palpebral lobes conspicuous, highly arched, outwardly bounded by distinct narrow borders, granulate; palpebral grooves very distinct, deep at front and back and thus contracting the genal lobes, passing posteriorly round and under the eyes into the lateral extensions of the neck furrow, adding relief to that organ; genal lobes tumid and deltiform; genal angles rounded and faceted; when the thickened borders fall out deep grooves are left. Eyes equal to half the length of cheeks, seventeen rows of lenses, the maximum number in a row being five; cornea and walls of cups thick; lentiferous face, antero-posteriorly, has a semicardiod curve.

Thorax.—As wide as long, very gently contracting posteriorly, sides almost perpendicular, smooth; axis sharply ridged, rings nodular at bases and centrally bearing strong, short recurved spines; when decorticated it is semicylindrical, as wide as side lobes (not measuring the contour of lobes); axial furrows moderately distinct; side lobes horizontal between axial grooves and fulcræ, pleuræ slightly recurved, ends rounded in at the posterior angles; medial grooves distinct, reaching beyond the middle of the deflected ends in decorticated specimens, and triangular posterior ridges strong; little or no trace of granulation on any portion of the thorax.

Pygidium.—About semicircular, highly inflated; axis very prominent anteriorly, and terminating indistinctly at the inner edge of the border at about half of its anterior width, slightly depressed between the side lobes, shows eight rings and a terminal piece; the first three rings bear nodules centrally corresponding to the spines of the thoracic axis and are arched forward; each succeeding one becomes less distinct until the last is very

faint; side lobes tumid, seven or eight pleuræ on each; pleural grooves very distinct anteriorly; sutures and axial grooves distinct.

Obs.—This species was described by Foerste from a specimen sent to him by one of us. That specimen was distorted so that the true features of the head were indiscernible, particularly those of the eyes. In fixing the maximum number of lenses in the vertical rows at nine he is in error, for in a number of eyes examined by us the lenses in a row do not exceed five. By fore and aft compression it is not unusual to find an eye with two rows brought into the same vertical line, and in this way appearing to have nine or ten lenses in a vertical row. This is probably the case with Foerste's type specimen.

We are inclined to agree with Foerste in ranking this as a species, for certainly it is very clearly separated from *P. fecundus*, Barr., by the greater inflation of the front of the glabella, the much smaller eye, the less distinct groove passing under the front of the glabella, the absence of granulation on the thorax, thinner test, straighter sides of glabella, greater perpendicularity of the sides of the thorax, greater distinctness of the pleural grooves on the pygidium, smaller size of the animal, and above all the presence of the very conspicuous dorsal spines. This latter feature separates it from all species of the genus known to us.

From *P. Crossleii*, nobis, it is not separable except by the dorsal spines, and it may be that this feature is a sexual one, and the two forms represent the male and female of the one species. In a comparison of a number of heads of the two forms those of *P. serratus*, Foerste, seem to be more tumid in front and to have the glabella more sharply contracted behind by the intercalary groove.

Loc. and Horizon.—Near Railway Station, Bowning, N.S.W. Upper Trilobite Bed, Bowning Series—? Wenlock. *Coll.*—Mitchell.

PHACOPS SWEETI, *sp. nov.*

(Pl. xxxviii., fig. 9; Pl. xxxix., figs. 1, 2; Pl. xl., fig. 10.)

[Compare *Phacops (Odontochile) fecundus*, McCoy (? non Barr.), Prod. Pal. Vict. 1876, Dec. iii. p. 15, t. 22, f. 8-9, t. 23, f. 1-6.]

Sp. Char.—*Body*—Oblong oval. *Head-shield or cephalon*.—Subsemicircular, width rather greater than twice its length. Glabella, including the neck ring, about five-sixths of the greatest width, very slightly convex above, slightly subpentagonal, overhanging very little in front, sides straight and steep, limb very rudimentary, and the furrow between it and the glabella faint; three pairs of lateral grooves present, frontal pair passing out at the front angles and running obliquely across the glabella, terminating subfalcately; second pair opposite posterior horns of eyes, both of these pairs are linear; intercalary groove moderately distinct, wide and shallow; intercalary ring with well-marked nodules at each end; the whole glabella surface ornamented with various-sized granules, and wrinkled in front subvertically; neck furrow shallow, moderately distinct, and continued across and round the side lobes, becoming very shallow as it reaches the borders, and continuing so in its frontal extension; neck ring distinct, ends nodular; axial furrows distinct and wide and genal lobes sloping rather steeply into them; lateral lobes subtriangular(equilateral), borders thickened, ridges along posterior faces between the axial furrows and fulcra robust; imbricating facets large; genal lobes highly convex and granulated, separated from the palpebral lobes by a faint furrow* which passes posteriorly around and under the eye, giving relief to that organ, and joining the lateral prolongation of the neck furrow and enclosing between them a suboblong tumose area or extension of the genal lobe. Eyes very large, half as long as postero-anterior length of head, anteriorly almost resting on the cheek borders, being separated from them by the fainter lateral furrows only; normal number of vertical rows of lenses twenty-two, closely packed, tolerably convex, with twelve lenses in each of the central rows, the total number of lenses in each eye being about 220; in the cups the attachment processes visible under a lens; cornea seems to have been thin; lentiferous face curved from front to back lunately,

* This may be termed the palpebral furrow, and should perhaps be considered a generic character.

and sloping upwardly at an angle of 60° to 70° ; height of each eye about two-thirds of its length, in front barely reaching the front angles of the glabella, posteriorly in a line with the central portion of the intercalary furrow.

Thorax.—Of eleven segments, width seems a little greater than length; axis prominent, contracts very gradually posteriorly from the sixth segment, terminating with a width about four-fifths of the anterior width; segments nodular at the ends; lateral lobes very little wider than the axis, horizontal between fulcra and axial furrows, deflected portion steep, component pleuræ imbricate and rounded at the ends; pleural furrows distinct and wide, seeming to reach nearly to the ends; anterior ridges of pleuræ triangular, posterior very narrow; interpleural sutures and axial furrows distinct.

Pygidium.—Subsemicircular or subquadrilateral, width greater than twice the length; axis tolerably prominent, seven segments visible, terminating bluntly with about half the anterior width at the border, slightly sunk between the lateral lobes, which are moderately inflated, horizontal between fulcra and axial grooves, anteriorly deflected to correspond with pleuræ of thorax, but posteriorly becoming less steep; five to six pleuræ visible on each lobe, only the two anterior ones showing the pleural furrows and sutures distinctly, the furrows reach the border, anterior face straight, axial grooves moderately distinct. The whole surface shows evidence of granulation.

Obs.—This species approaches *P. fecundus*, Barr., very closely, but we consider there are sufficient differences between them to justify us in giving specific rank to our form. Its most conspicuous feature is the great size of the eyes, in which respect it surpasses *P. fecundus*, Barr., and many other species of the genus, and as in all the mature specimens that have come under our notice, twenty-two vertical rows of lenses containing twelve in each row are constant features, while in *P. fecundus*, Barr., nineteen vertical rows with nine lenses in a row are the normal features, we consider this to be a sufficient difference for specific

separation. It differs from *P. Crossleii* by the much greater length of its genal lobes, which are conspicuously large. With our *P. latigenalis* it agrees in having a great length of cheek between the posterior angle of the eye and the genal angle.

The glabella of this species appears to have been granulated in the manner common to the genus, but our specimens are all decorticated, and the indications of granulation are observable on the moulds only.

The neck ring of *P. Sweeti* is proportionately wider than either of the N.S. Wales species, which would indicate a wider proportionate axis. That it is quite distinct from *P. Crossleii* and *P. latigenalis* is very clear on (*a*) the greater number of eyelets on each eye and the unvarying character of the eye; (*b*) the perpendicular glabella sides; (*c*) distinctness of the lateral furrows of the glabella on large specimens; and (*d*) the smallness of the basal lobes of the glabella.

We have received a very well-preserved head from Mr. G. Sweet (Pl. xxxix., fig. 2), which he informs us is the usual form of *P. fecundus*, McCoy (!non Barr.). We believe it to be identical with the species above described, but still think that it is distinct from *P. fecundus*, Barr. By this specimen we observe that the glabella sides are perpendicular, the nodules of the intercalary ring lie right in the path of the axial furrows, and that the lobes between the intercalary and basal glabella furrows are very small. All these features separate it from the N.S. Wales forms, and the perpendicularity of the sides of the glabella is a feature not possessed by *P. fecundus*, Barr. The whole form of the glabella approaches as near to the quadrate as the pentagonal form.

It is not for us to dogmatise on this point, nor to adversely criticise the work of so accurate an observer as Sir F. McCoy. The above is simply our united opinions based on the material we have been able to accumulate.

Loc. and Horizon.—Mansfield District, Victoria—?Upper Silurian. *Coll.*—G. Sweet, Melbourne.

PHACOPS MANSFIELDENSIS, *sp. nov.*

(Pl. xxxix., fig. 12.)

Sp. char.—*Head-shield or cephalon.*—Twice as wide as long. Glabella subpentagonal, rounded in front, very tumid, intensely contracted behind by the intercalary furrow, sides straight and nearly perpendicular; intercalary furrow distinct and terminating on each side in remarkably deep punctures, intercalary ring prominent and nodular at base; no lateral glabella furrows noticeable; neck furrow distinct, and as it passes into the axial grooves forms very deep punctures or pits, continuing across the lateral lobes with equal distinctness; neck ring highly arched, curving back and nodular; fixed cheeks small, genal lobe prominent, highly arched; palpebral furrow distinct, passing posteriorly round and under the eye; axial grooves wide and deep. Eyes prominent, large, rather longer than half the length of the cheek, separated from the thickened edges of the cheeks by wide or shallow furrows; free cheeks coalesced, margins thickened and straight in front of the eye, giving to the cephalon a triangular character; genal angles terminate in short spines.

Obs.—We have only a decorticated cephalon of this species, which has unfortunately been somewhat contorted and is apparently an immature individual; but the features present clearly separate it from other known Australian forms. Foremost among these features are the genal spines, the great contraction of the glabella by the intercalary furrow, and the very deep punctures on each side of this furrow and of the neck furrow. The genal spines separate it from all described Australian species of this genus. It is further separated from our other Victorian species by having the nodules of the intercalary ring behind the glabella basal lobes instead of in the axial grooves. The great contraction of the glabella by the intercalary arch gives to the tumid portion of the glabella a subcircular contour. The greatest number of eyelets in a vertical row appears to be six.

The presence of the genal spines separates this species from *Phacops* proper, but through the scantiness of our material we are not prepared to enunciate a more definite opinion at present.

Loc. and Horizon.—Mansfield District, Victoria—? Upper Silurian. *Coll.*—G. Sweet, Melbourne.

Genus HAUSMANNIA, Hall and Clarke, 1888.

Dalmania, Emmrich (*non* Desvoidey, 1830),* Jahrb. für Min., 1845, p. 38.

Odontochile, Corda (*non* Laporte, 1834),† Prod. Mon. Böh. Trilobiten, 1847, p. 92.

Phacops (*Dalmania*), Salter, Dec. Geol. Survey U.K., 1849, ii. p. 1.

Dalmania, Barrande, Syst. Sil. Bohême, 1852, I. p. 528.

Dalmanites, Barrande, *Loc. cit.*, p. 918, and Expl. Plates, Atlas i.

Dalmanites, Barrande, *Loc. cit.*, 1872, Suppl. Vol. i. p. 27.

Phacops (*Odontochile*), Salter, Mon. Brit. Trilobites, 1864, Pt. 1, p. 15.

Dalmanites, Hall, 11th Ann. Rep. Geol. Survey Indiana, 1881, p. 329.

Dalmanites (*Hausmannia*), Hall and Clarke, Pal. N. York, 1888, vii. pp. xxix and xxxi.

Obs.—In separating the old genus *Phacops* into convenient sections for systematic description the late Mr. J. W. Salter adopted the name *Odontochile*, Corda, for that group typified by *Phacops caudatus*, Emm., but for which the term *Dalmania* has otherwise almost universally been used. The latter name, proposed by Emmrich in 1845, had, however, been previously used by Robineau-Desvoidey for a genus of Diptera, and therefore became invalidated as a generic name for Trilobites. Unfortunately also *Odontochile*, proposed by Corda in 1847, was inapplicable from the fact that it was made use of in 1834 by Laporte to represent a genus of Coleoptera.

* *Dalmania*, Desvoidey, 1830, a genus of Diptera.

† *Odontochile*, Laporte, 1834, a genus of Coleoptera.

The previous use of *Dalmania* seems to have escaped the notice of Barrande, for we find him using the name throughout the first volume of his magnificent work on the Bohemian Silurian System, until nearly the close of the volume, when for a single species in the Addenda, the word *Dalmanites* is employed, and continues throughout the atlas. It is therefore possible that in the interval Barrande discovered the inutility of the name *Dalmania*, and by the use of the termination *ites* sought to discriminate between *Dalmania*, Emmrich, and *Dalmanites*, Barrande. At the same time an objection has been raised by some authors that even *Dalmanites* is not sufficiently distinctive.

Prof. James Hall, in one of his numerous critical contributions to American Palæontology, seems inclined to advocate the claims of *Odontocephalus*, Conrad, 1840 (= *Cryphæus*, Green, 1837, *non Cryphæus*, Klug, 1833, a genus of Coleoptera; and *Pleuracanthus*, M. Edw., 1840, *non Pleuracanthus*, Ag., 1837, an Ichthyodorulite). If, however, *Odontocephalus* is restricted to forms resembling its type species, *Asaphus selenurus*, Eaton (= *Calymene odontocephala*, Green), in which the anterior border of the cephalon is denticulated or fimbriated, a good generic distinction, it cannot possibly clash with *Dalmanites*. Indeed, we imagine this had already struck Prof. Hall, for in the seventh Vol. of the Palæontology of New York, by himself and Mr. J. M. Clarke, we find both names acknowledged much on the lines now explained. *Pleuracanthus* might have been adopted had not Agassiz in 1837 made use of the term for an Ichthyodorulite.

Unless we have overlooked any step in the discrimination of this generic type, and that is not impossible, there remain two courses open to us—either to adopt *Dalmanites*, following Barrande, or to propose a new genus. We are loth to adopt the latter alternative, more especially as Hall and Clarke have proposed as a subgenus under *Dalmanites* the name *Hausmannia*, with practically the same characters as the genus proper. They remark, “It is here proposed to group under the type *Hausmannia* the typical and unvaried forms of *Dalmanites*, which follow the

type of *D. caudatus* (Brünnich) Emmrich, and *D. Hausmanni*, Brongniart."

Under these circumstances, the adoption of *Hausmannia* in place of *Dalmanites* will surmount all difficulties in connection with the latter name. This suggestion is strengthened by the fact that Barrande's *Dalmanites*, as pointed out by Schmidt, included Trilobites not only of the type of *Asaphus caudatus*, but also all other Phacopidae which did not agree with *Phacops* as restricted by him, and are comprised by other writers in *Acaste* and *Chasmops*.

HAUSMANNIA MERIDIANUS, *sp. nov.*

(Pl. XXXVIII., figs. 1-8; Pl. XL., fig. 1.)

Phacops (Odontochile) caudatus, McCoy (*non* Brünnich), Prod.

Pal. Vict. Dec. iii. 1876, p. 13, t. 22, f. 1-7; t. 23, f. 7-10.

Sp. Char.—*Body*.—Oblong ovoid. *Head-shield or cephalon*.—Semicircular, finely granulated, moderately inflated, surrounded by a thickened limb marked off from the cheeks and glabella by a fairly conspicuous groove. Glabella large, subpyriform, with straight and oblique sides, separated from the cheeks by deep and wide axial furrows; frontal lobes very tumose, and together sub-elliptical in shape, and in some specimens overhanging the furrows very slightly; the remaining lobes are flat and small, second pair subtriangular, third and posterior pair oblong; frontal furrows wide, and moderately deep, joining the axial furrows just in front of the eye, crossing the glabella very obliquely and almost meeting, the basal and median pairs linear, deep, and slit-like (in casts), and not reaching the axial furrows; posterior corners of basal lobes sloping rapidly into the axial furrows; fixed cheeks small, genal lobe* inflated, sloping rapidly into the axial furrow, separated from the palpebral lobe by a distinct groove, which anteriorly passes into the axial groove, and posteriorly passes round and under the eye; free cheeks large,

* That portion of the fixed cheek between the palpebral lobe and the axial furrow.

continuous, conspicuously deflected laterally; genal angles produced into strong spines reaching to the sixth segment of the thorax; neck furrow distinct, particularly where it joins the axial furrows, continuing across the lateral lobes subfalcately with increasing distinctness and width; facial sutures anteriorly rather straight to the border, thence continuous, posterior portions from the hinder ends of the eyes passing out laterally and falcately, cutting the borders of the free cheeks in a line with the base of the eye. Eyes large, each has 32 to 40 or even more vertical rows of lenses with a normal number of eleven in each central row, and in odd cases twelve to fourteen, giving an aggregate of about 400 lenses in a single eye of some mature specimens; the lentiferous face forms a subsemicardioid curve, above sloping backward at an angle of about 40° , below bounded by a shallow groove, height diminishing more gradually posteriorly than anteriorly; lenses spherical, closely packed in the vertical rows, which are separated by distinct spaces or partitions.

Thorax.—About equal in length to the combined width of one pleural lobe, and the axis or about two-thirds of its total width, and greater than that of either the head or tail, suboblong or subfusiform; axis subfusiform, greatest width at fourth or fifth segment, where it is slightly greater than the width of the neck ring; arched most prominently posteriorly, rather flat anteriorly; segments thickened at their bases, moderately arched; some axes show faint trilobation caused by feeble depressions traversing their length, these depressions are accentuated by rows of tubercles, one on each side, about midway between the central line and the axial groove; pleuræ one and one-third times as wide as the thorax, and between the axial grooves and fulcra rather horizontal, outer ends moderately deflected and recurved, the latter feature becoming more pronounced posteriorly; pleural grooves wide and shallow, beginning at the angles of junction with the axial grooves and passing out posteriorly at the bases of the claw-like ends, thus traversing the pleuræ diagonally, anterior ridges much stronger than the posterior, and passing across to the posterior edges at about midway

between the fulcra and outer ends, obliterating the pleural grooves as above stated, outer ends flattened and claw-shaped, the latter feature very distinct on the posterior pleuræ; sutures very distinct; evidences of granulation very small; axial grooves moderately distinct.

Pygidium. — Distinctly triangular, proportion of width to length (leaving out the terminal spine) is about as three to two, moderately arched; axis very distinct, a few of the anterior segments arched forward centrally, and in decorticated specimens the same segments are provided with sub-triangular articular spaces; normal number of rings in fully developed specimens is sixteen to eighteen, and even attaining nineteen exclusive of the terminal appendage, no distinct traces of tubercles observed, sides straight, tapering gradually and in perfect specimens being inseparable from the produced spine, which is of varying length in different individuals; outer ends of the anterior segments bear large nodes bounded on their inner sides by slight depressions similar to those referred to on the thoracic segments; in some cases posteriorly depressed between the side lobes; axial grooves distinct, anchylosing margins of the side lobes straight between the fulcra, ends sharply recurved; in their inflation and deflection agree with the lobes of the thorax, but in some cases the slope is gradual from the axial grooves; eleven pleuræ, each succeeding one having a greater backward curve until the last is nearly parallel with the axis; pleural grooves wide and shallow; anterior ridges very distinct, thickening at the inner edge of the limb, and thence vanishing towards the outer edge, and forming a tuberculous ridge along the inner edge of the limb; sutures distinct; limb wide, its inner edge distinctly marked by a suture; to this limb the tail spine is attached.

Obs. — The rows containing the maximum number of lenses are alternately one lens higher and lower top and bottom than the preceding row, while the succeeding rows on each side are level top and bottom, and in this manner each of these rows fore and aft of the central portion loses a lens until the corner rows have the minimum of two to three lenses. The maximum of eleven

lenses in a vertical row appears to be normal for the examples from the Middle Trilobite Bed; but a specimen from the Upper Trilobite Bed has thirteen to fourteen lenses in the central rows. The tail spine is anchylosed to the border, and when the border and spine are removed a short dagger-like extension of the axis is exposed, such as is shown in most of the figures of the European *H. caudatus*. It is in this condition that the tail of our species bears a strong resemblance to *H. caudatus*; but whatever may be the case in the latter, it is, judging from the evidence furnished by a large number of specimens, almost certain that, in every instance where the tail of our species exhibits the short deltoid form of spine, the true spine has suffered removal.

We believe the forms figured by McCoy from the Victorian Upper Silurian as *Phacops (Odontochile) caudatus* to be the same as our *H. meridianus*. His figures show the much longer eye and multisegmented pygidial axis; but McCoy's glabellæ are granulate. *H. meridianus*, both as regards the N.S. Wales and Victorian specimens is so finely granulate throughout as to be practically smooth without a lens.

Touching the relation of our species to the typical European *H. caudatus*, Brün., the eyes are proportionately further forward in *H. meridianus*, the palpebral lobes and genal lobes wider transversely, and there is no neck tubercle. The eyes are less lunate, or arched in contour, and consequently longer fore and aft, and the surface of the glabella non-tuberculate. The pygidia differ in the excess of segments over those of *H. caudatus*, possessing seldom less than sixteen in the axis of the smaller pygidia, and usually eighteen or nineteen exclusive of the terminal appendage. Victorian and N.S. Wales specimens agree in this. Our form is also long tail-spined when perfect, thus resembling *H. longicaudatus*, but unlike the latter we have never seen an individual bearing a frontal spine. As regards the form of the glabella, *H. meridianus* seems to come nearer to *H. longicaudatus*. The genal spines are the same length in both the European and Australian forms. *H. caudatus* occasionally has a granulated pygidium axis,

but our species never has. Such granules are not to be confounded with the tubercular nodes at the outer ends of the segments.

H. meridianus vies in size with the large *H. Angelini*, Barr., from Étage D. of the Bohemian classification, and *H. rugosa*, Corda, but both of these are sub-mucronate in front, and possess much longer genal spines, and other points of departure.

It unquestionably falls into Hall and Clarke's section *Hausmannia*,* suggested by these authors for the "typical and unvaried forms of *Dalmanites*, which follow the type of *D. caudatus* (Brünnich) Emmrich, and *D. Hausmanni*, Brong." As, however, *D. caudatus* was selected by Barrande as the type of his genus *Dalmanites*, it follows that Hall and Clarke's term must be synonymous with the latter, a point that it is strange did not strike these eminent writers. At the same time we have here a solution of the generic difficulty, for if by common consent the name *Dalmanites* is not to stand, that proposed by the American Palæontologists will take its place.

The large increase in the number of pygidium segments in the Australian Trilobite is not peculiar to that species. *H. auriculata*, Barr., has twenty-three axial rings, *H. Hausmanni*, Brong.,† possesses eighteen, and several American species are found to have an increased number over that seen in the typical *H. caudatus*.

Loc. and Horizon.—Bowning, Co. Harden, Upper and Middle Trilobite Beds; Hatton's Corner, near Yass; Limestone Creek, near Bowning, Co. Harden—Bowning or Hume Series—? Wenlock. *Coll.*—Mitchell; Mining and Geol. Museum, Dept. Mines, Sydney; Australian Museum, Sydney.

D. meridianus is another of the most persistent of our Upper Silurian forms, being met with near the base, and also at the close of the Bowning Series.

* Pal. N. York, 1888, vii. p. xxxi.

† Burmeister, Organization of Trilobites (*Ray Soc.*), 1846, t. 5, f. 10.

In Victoria it is found in the olive mudstones of Broadhurst's Creek, near Kilmore, and in the arenaceous beds of Yerring, Upper Yarra.

In Tasmania the species occurs in the Despatch Limestone of Zeehan and Heazlewood, N.W. Tasmania.

EXPLANATION OF PLATES.

Plate XXXVIII.

HAUSMANNIA MERIDIANUS, *E. and M.*

- Fig. 1.—An almost entire specimen; Bowning. *Coll. Mitchell.*
 Fig. 2.—Pygidium showing the increased number of segments, absence of test on the limb, and the acicular spine; Bowning. *Coll. Mining and Geol. Museum.*
 Fig. 3.—Pygidium of a young individual with a well-developed acicular spine; Bowning. *Coll. Ibid.*
 Fig. 4.—Glabella, portion of fixed cheeks, and one eye. Frontal lobe elliptical and strong eye lobes; Bowning. *Coll. Mitchell.*
 Fig. 5.—Portion of cephalic shield showing the right facial suture and form of the eye lobe; Bowning. *Coll. Mitchell.*
 Fig. 6.—An eye and palpebral lobe, $\times 3$. *Coll. Mitchell.*
 Fig. 7.—Free cheek showing course of posterior portion of left facial suture, and the genal spine; Bowning. *Coll. Mitchell.*
 Fig. 8.—Hypostome. *Coll. Mitchell.*

PHACOPS SWEETI, *E. and M.*

- Fig. 9.—Partially rolled specimen, with thorax and pygidium; Mansfield District, Vict. *Coll. Sweet.*

Plate XXXIX.

PHACOPS SWEETI, *E. and M.*

- Fig. 1.—Cephalic shield somewhat distorted by pressure, but with the left eye intact; Mansfield District, Vict. *Coll. Sweet.*
 Fig. 2.—Decorticated cephalic shield showing the quadrate contour of the cephalic shield, small basal lobes, intercalary nodules, neck ring, and eyes; Mansfield District, Vict. *Coll. Sweet.*

PHACOPS LATIGENALIS, *E. and M.*

- Fig. 3.—Cephalic shield slightly distorted; Bowning. *Coll. Mitchell.*
 Fig. 4.—Portion of another cephalic shield slightly distorted, showing glabella furrows and rounded genal angle; Bowning. *Coll. Mining and Geol. Museum.*
 Fig. 5.—Another cephalic shield, showing the deep glabella furrows and axial grooves, tumid glabella, wide frontal lobe, and left intercalary nodule; Bowning. *Coll. Mitchell.*
 Fig. 6.—Front and under view of cephalon, showing (a) rudimentary limb, (b) linear ridge and (c) roof of mouth; Bowning. *Coll. Mitchell.*

PHACOPS SERRATUS, *Foerste.*

- Fig. 7.—Portion of the glabella and thorax; Bowning. *Coll. Mitchell.*
 Fig. 8.—Thorax, side view, showing the bluntly spined median line of the segments; Bowning. *Coll. Mitchell.*

PHACOPS CROSSLEII, *E. and M.*

- Fig. 9.—Thorax and pygidium; Bowning. *Coll. Mitchell.*
 Fig. 10.—Cephalic shield, with the furrows, eyes, neck ring, intercalary nodules, and rounded genal angles; Bowning. *Coll. Mitchell.*
 Fig. 11.—Cephalic shield and portion of thorax; Bowning. *Coll. Mitchell.*

PHACOPS MANSFIELDENSIS, *E. and M.*

- Fig. 12.—Portion of a cephalic shield showing a very tumid and subpentagonal glabella, and a strong intercalary furrow, $\times 2$; Mansfield District, Vict. *Coll. Sweet.*

Plate XL.

HAUSMANNIA MERIDIANUS, *E and M.*

- Fig. 1.—Portion of head shield; Kilmore, Vict. *Coll. Mining and Geol. Museum.*

PHACOPS LATIGENALIS, *E. and M.*

- Fig. 2.—Large cephalic shield distorted, showing the tumid glabella and coarse granulation; Bowning. *Coll. Mitchell.*
 Fig. 3.—Portion of a pygidium; Bowning. *Coll. Mining and Geol. Museum.*
 Fig. 4.—Another pygidium of large dimensions, believed to be that of this species; Bowning. *Coll. Mitchell.*
 Fig. 5.—Portion of head and thorax; Bowning. *Coll. Mitchell.*

Fig. 6.—Young specimen—portion of cephalic shield, with linear glabella furrows; Bowning. *Coll. Mitchell.*

PHACOPS SERRATUS, *Foerste.*

Fig. 7.—Portion of cephalic shield; Bowning. *Coll. Mitchell.*

Fig. 8.—Portion of another cephalic shield, tumid glabella, and neck tubercle; Bowning. *Coll. Mitchell.*

PHACOPS LATIGENALIS, *E. and M.*

Fig. 9.—Rostral shield with the hypostome *in situ*; Bowning. *Coll. Mitchell.*

PHACOPS SWEETI, *E. and M.*

Fig. 10.—Central portion of an eye, $\times 2$; Mansfield District, Vict. *Coll. Sweet.*

PHACOPS SERRATUS, *Foerste.*

Fig. 11.—Side view of the cephalic shield, with the neck spine prominently shown.

All the figures, unless otherwise indicated, are of the natural size.

BOTANICAL NOTES FROM THE TECHNOLOGICAL MUSEUM.

BY J. H. MAIDEN, F.L.S., AND R. T. BAKER, F.L.S.

No. IV.

(Plates XLI.-XLII.)

PITTOSPOREÆ.

HYMENOSPORUM FLAVUM, F.v.M.

This species occurs in brush forests near Wyong, its previous recorded southern limit being the Hunter River.

TILIACEÆ.

ELÆOCARPUS EUMUNDI, Bail.

This species was first described by Mr. F. M. Bailey, who discovered it in the Queensland locality from which it derives its specific name. It has since been obtained in fruit at Mullumbimby, Brunswick River (W.B.).

It is therefore new for New South Wales.

RUTACEÆ.

BORONIA MOLLIS, A. Cunn.

This species was for a long time only known from the Nepean and as far north as Port Macquarie. It has recently been collected at Murrumbidgee, Goulburn River (R.T.B.), which for the present is its most western locality.

SAPINDACEÆ.

RATONIA ANODONTA, Benth.

Since recorded in our Bot. Notes No. III. as new for New South Wales, it has been collected as far south as Burrell's Creek,

near Tinonee, by one of us, and in the county of Gloucester by Mr. A. Rudder, of the Forest Department.

LEGUMINOSÆ.

RHYNCHOSIA CUNNINGHAMII, Benth.

This species has been collected at Lismore (W.B.), and is therefore new for this colony.

LEGUMINOSÆ.

SWAINSONA PHACIFOLIA, F.v.M.

(Syn. *Swainsona stipularis*, F.v.M.)

This species has been collected as far east as Bathurst (W. J. C. Ross, B.Sc.).

ACACIA AULACOCARPA, A. Cunn.

A very plentiful species at Woodburn, on the Richmond River, where some trees measure over 80 feet in height and 3 feet in diameter. It has previously only been recorded from Queensland, so is therefore new for New South Wales.

ACACIA JONESII, F.v.M. et J.H.M.

Abundant in a gully at Kenmore, near Goulburn (J.H.M.).

SAXIFRAGÆÆ.

CERATOPETALUM GUMMIFERUM, Sm.

Has recently been found at Woodburn, Richmond River (W.B.), where it attains a height of over 50 feet and a diameter of 16 inches.

Its range, as far as we at present know it, is right along the coastal districts from the Moruya River to the Richmond River, attaining tree size throughout perhaps the whole of its range.

MYRTACEÆ.

EUCALYPTUS TRACHYPHLOIA, F.v.M.

This species has been collected at Cox's Gap, Murrumbo, Goulburn River (R.T.B.), and now is recorded for the first time for N.S.W. Its fruit and bark very much resemble some forms of *E. corymbosa*, to which it is very closely related.

APOCYNÆÆ.

CHILOCARPUS AUSTRALIS, F.v.M.

In all the published descriptions of this species the flowers are stated to be yellow. We have now to record a white flowering form from Woodburn, Richmond River.

MONIMIACEÆ.

PIPTOCALYX MOOREI, Oliv.

(Plate XLI.)

It is only within the last few months that the fruits of this species have been brought to light. The plant has been known for many years, but has recently come into prominence through its bitter leaves, which have been introduced into Europe as a substitute for hops (*Agricultural Gazette of N.S.W.* v. 545). It has been recently figured, but without the fruits, in Hooker's *Icones Plantarum* (Vol. iv. Part 3, Pl. 2367). The plant figured differs from our specimens in being glabrous, while all known to us are rusty pubescent.

The fruiting perianth is oval in shape with a constricted base, and measures scarcely 2 lines in length and 1 line in diameter; colour purple when fully ripe, glabrous, fleshy with a hard muricate endocarp.

Seed with a membranous testa, pendulous from the apex of the cavity with a short hilum.

Hab.—We have received it from several localities, and its range as far as at present known may be stated as mountain ranges between the head waters of the Clarence and Macleay Rivers.

We have had the opportunity not only of examining these fruits for the first time, but as our specimens were perfectly fresh we are enabled to offer a complete and accurate plate of the species.

LAURINEÆ.

Bentham (B.Fl.v. 297) includes under *Cryptocarya glaucescens*, R.Br., one and perhaps more than one plant which examination of additional material has shown us to be worthy of separate specific rank. We propose to deal with one particular plant, and will endeavour to show that *C. glaucescens*, R.Br., var. *reticulata*, Meissn., is undoubtedly a good species, and that the name *C. microneura*, Meissn., should be revived for it. We will now, with the complete material and extended observations available to us, describe the species.

CRYPTOCARYA MICRONEURA, Meissn. in DC. *Prod.* xv. 27.

(Syn. *C. glaucescens*, R.Br., var. *reticulata*, Meissn., B.Fl. *loc. cit.*)

(Plate XLII.)

A tree over 60 feet high, glabrous except the inflorescence, which is always hoary-pubescent. Leaves broadly lanceolate, acuminate, obtuse, glabrous on both sides, a shade darker on the upper side, primary veins and reticulations equally distinct on both sides, reticulations fine but more distinct than in *C. glaucescens*, 6 inches long and 1 broad; petiole short, less than $\frac{1}{2}$ in. Flowers very numerous, mostly terminating in a large irregular panicle, but sometimes axillary. Perianth under 1 line, hoary pubescent, the tube turbinate, about equal to the lobes. Glands stipitate at the mouth of the tube. Staminodia scarcely sessile as in *C. glaucescens* and very much more acuminate. Fruiting perianth ovoid-oblong, 6-8 lines long, dark, shining, faintly ribbed.

Brief analysis showing relations to cognate species.

Leaves *thickly coriaceous*, smooth, shining above, the primary veins very prominent underneath, the reticulations inconspicuous.

Fruit globular.

C. obovata.

Leaves more or less coriaceous, the reticulations fine, conspicuous or obsolete on both sides.

Fruit globular.

C. glaucescens.

Leaves thinly coriaceous, the reticulations fine on both sides.

Fruit ovoid-elliptical.

C. microneura.

C. glaucescens and *C. microneura* are found intermingled in the brushes along the whole northern coast districts of this colony as well as Illawarra, and their distinct character (without any intermediate forms that we can trace), is maintained throughout.

This species differs from *C. glaucescens* in colour, texture and shape of its leaves, in its absence of glaucousness, and particularly in the shape of its fruits. The reticulations are also more prominent than in the former species, and the specific name is very appropriate. The staminodia are also more acuminate. The fruiting perianth is entirely distinct; in *C. glaucescens* it is "depressed-globular," a shape uniformly maintained throughout the whole range of the typical species, but in this species it is ovoid-elliptical and consistently so. It measures about 6-8 lines long and 3-4 broad, is black and shining and faintly ribbed. The fruits of *C. microneura* have not hitherto been described. In fine, we have repeatedly examined the two species in the brushes from Illawarra to Port Macquarie, and have requested Mr. Baeuerlen, the botanical collector of the Museum, to make similar observations on the Richmond River. Our observations agree in that we are convinced that the trees are distinct.

PROTEACEÆ.

PETROPHILA PEDUNCULATA, R.Br.

This species has been collected at Bundanoon, near Moss Vale, by Mr. A. J. Sach, of Goulburn, which is at present its most southern recorded limit.

FILICES.

POLYPODIUM ASPIDIODES, Bail.

This species is first recorded and described by F. M. Bailey in the Synopsis of Queensland Flora, p. 714, where he speaks of it as "a beautiful fern which has for a long time been confused with *Lastrea acuminata*, T. Moore, the *Aspidium acuminatum*, Hort. Ang., and from which it only differs in the entire absence of indusium and in the longer and more aculeate marginal teeth."

We are led to confirm these observations to the extent of stating that we have examined a very large number of fronds of this interesting fern in all stages of growth, and have failed to detect on them a trace of indusium. The sori are usually flesh-coloured, or at least quite different in colour from those of *Aspidium aculeatum*, nor is it ever found proliferous like that species. It has been found at Tintenbar (W.B.), near Ballina, Richmond River, and so is an addition to the plants of this colony.

FUNGI.

COPRINUS COMATUS, Fries.

This well-known European edible fungus has been recently found abundantly at Annandale, near Sydney. Cooke in his "Australian Fungi" records it for Victoria only. It is a good ketchup fungus.

EXPLANATION OF PLATES.

Plate XLI.

Piptocalyx Moorei, Oliv.

Fig. 1.—Bud.

Fig. 2.—Expanded flower.

Fig. 3.—Part of raceme with early fruit.

Fig. 4.—Individual fruit.

Fig. 5.—Transverse and longitudinal sections of fruit.

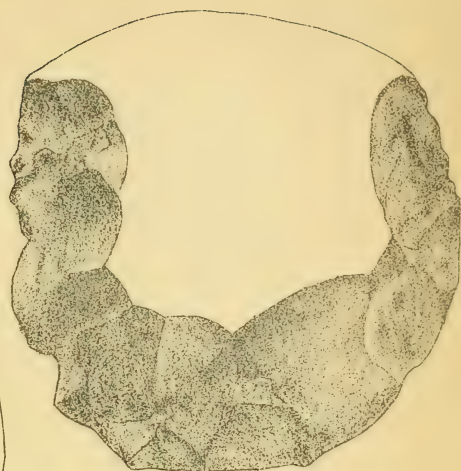
Fig. 6.—Seed.

Plate XLII.

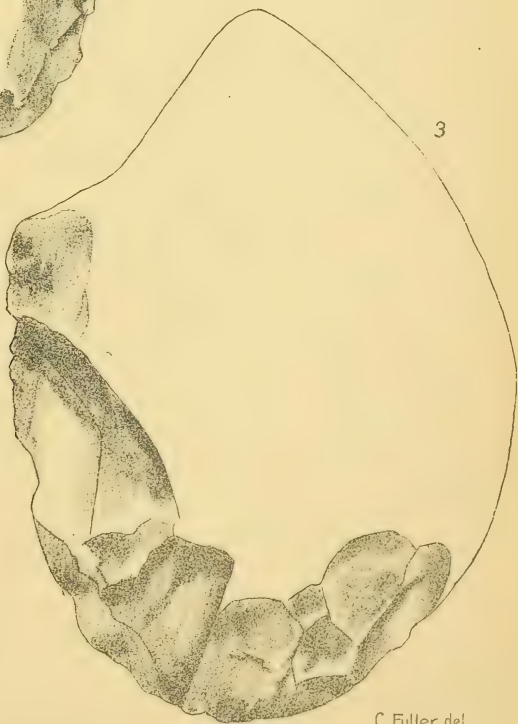
Cryptocarya microneura, Meissn.

- Fig. 1.—Flowering twig.
Fig. 2.—Bud.
Fig. 3.—Perianth.
Fig. 3'.—Expanded flower.
Fig. 4.—Stamen.
Fig. 5.—Staminodia (different views).
Fig. 6.—Gland.
Fig. 7.—Fruiting perianth.

All enlarged to various extent.



2



3



4

$\frac{2}{3}$ Nat Size

C. Fuller, del

NOTES AND EXHIBITS.

Mr. North exhibited a set of four eggs of *Turnix leucogaster*, recently described by him. The eggs were taken at Illamurta, Central Australia, on the 18th of June, 1895; and are of a buffy-white ground-colour, minutely freckled and sparingly spotted with different shades of chestnut-brown, purplish-brown, and violet-grey; an average specimen measuring 0·9 × 0·73 inch.

Mr. Steel showed a very large specimen of a ship-worm (*Teredo*) from redgum (?) piles in the fresh water of the Rewa River, Fiji, collected by Mr. T. Ferguson.

Mr. Froggatt showed a representative collection of some eighty named species of Australian Ants (*Formicidæ*). Also specimens of a beetle (*Arthropterus brevis*, Westw.) belonging to the family *Paussidæ*, captured in the nests of a common Australian Ant (*Ecatomma metallicum*). African species of this family commonly occur in such situations, but the exhibitor was unaware of any record of this habit in Australian species.

Messrs. Maiden and Baker exhibited a number of plants and photos in illustration of their paper.

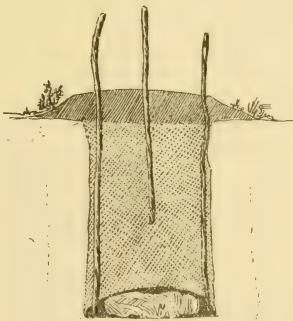
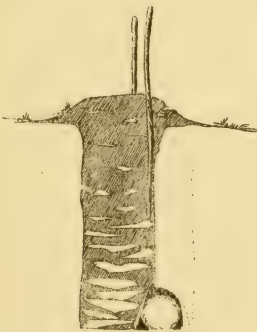
Messrs. Etheridge and Mitchell exhibited a number of Trilobites in illustration of their paper.

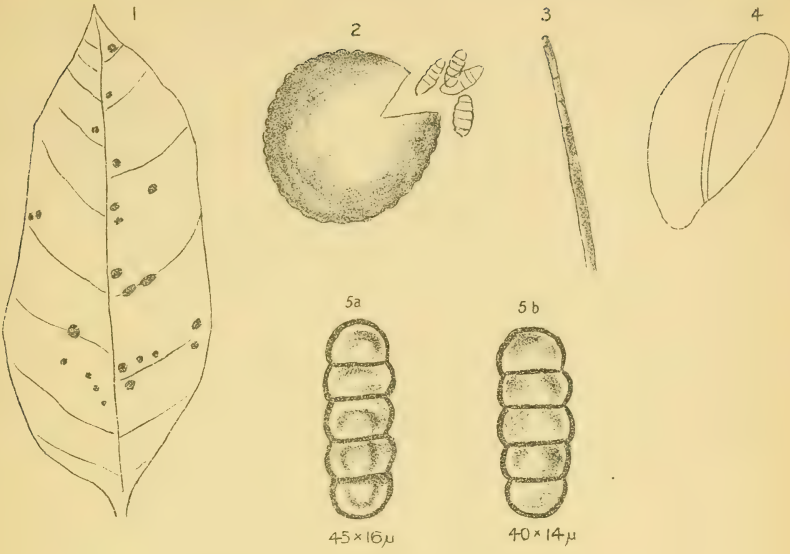
Mr. Mitchell exhibited several specimens of *Glossopteris* from Croudace's Hill, near Lambton, Newcastle, showing very apparent evidences of what is probably fructification similar to that of an *Asplenium*. Some specimens of a like character were collected by him from the cliffs on the Old Race Course Beach. Also a specimen of what appears to be a *Lycopodium*, near *L. guthieri*, Göpp., or *L. macrophyllum*, Gold., from the South Bulli Colliery. This is the first record of a fossil Lycopod from the New South Wales coal-bearing series.

Mr. Henn exhibited, on behalf of Mrs. G. J. Waterhouse, a very fine collection of *Cypræidæ*, found alive by herself and sons in Port Jackson, between the months of May and August of this year. The collection consisted of exactly 100 specimens belonging to the seventeen following species:—*Cypræa fimbriata*, Gmelin, *C. macula*, A. Ad., *C. felina*, Gmelin, *C. assellus*, Linn., *C. tabescens*, Solander, *C. arabica*, Linn., *C. moneta*, Linn., *C. annulus*, Linn., *C. caput-serpentis*, Linn., *C. helvola*, Linn., *C. clandestina*, Linn., *C. flaveola*, Linn., *C. lutea*, Gronovius, *C. comptoni*, Gray, *C. errosa*, Linn., *C. erronea*, Linn., and *C. interpunctata*, Brazier, MS. The last, (of which two specimens were found) differs from *C. macula*,—which it otherwise much resembles—in being more pyriform, and much more profusely and distinctly marked with spots. It is considered by Mr. Brazier to be a distinct new species, but it would, perhaps, be more correctly described as *C. macula*, A. Ad., var. *interpunctata*, Brazier.

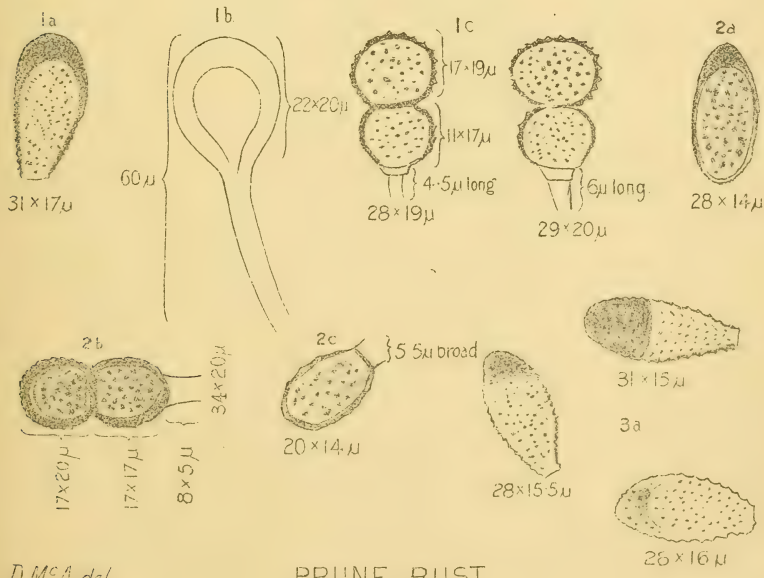
Of the above, no less than nine species, viz.: *C. fimbriata*, *tabescens*, *arabica*, *moneta*, *helvola*, *flaveola*, *lutea*, *comptoni*, and *interpunctata*, have never been previously recorded from Port Jackson. The *Cypræidæ* are amongst the rarest shells in the harbour, and very few—even dead—specimens have come to light for some years past. It is all the more remarkable therefore that so large a number of species should suddenly be discovered. They were found under stones rather below extreme low water mark and, with two exceptions, all within a radius of one hundred yards. In addition to the above, Mrs. Waterhouse also found dead specimens of *C. caput-anguis* and *C. hirundo* in very good condition, neither of which has been previously recorded from Port Jackson.

Mr. Henn also exhibited three extremely fine specimens of *C. vitellus*, Linn., and a specimen of *Micromelo guamensis*, Quoy et Gaimard, all found alive at Botany Heads by Mr. Norman Hansard in July. The latter very beautiful little shell has never been recorded from Australia previously, but is a native of the South Sea Islands.



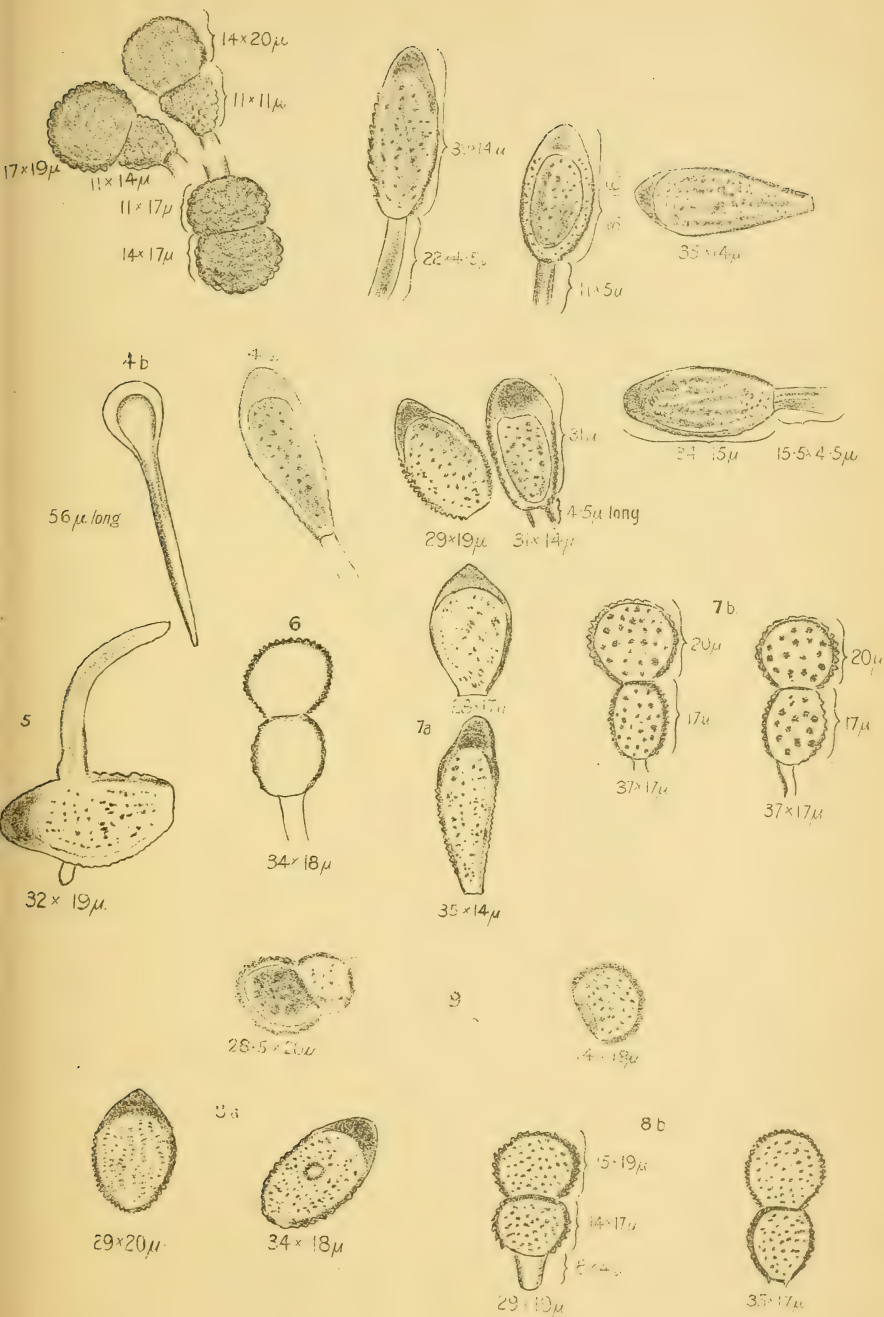


Meliola amphitricha, Fries.



D.McA del.

PRUNE RUST



PRUNE RUST

10b.



$4.4 \times 1.4 \mu$



$29 \times 17 \mu$



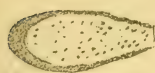
$32 \times 16 \mu$



$30 \times 5 \mu$



$31 \times 18 \mu$



$31 \times 14 \mu$

11

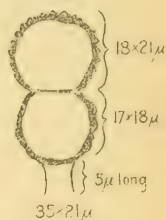


$31 \times 12.5 \mu$



$32 \times 14 \mu$

12b



$35 \times 21 \mu$



13a

4μ broad

54μ



$35 \times 17 \mu$



$37 \times 18 \mu$

$62 \times 4 \mu$



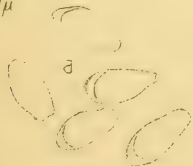
4μ broad

$31 \times 15 \mu$



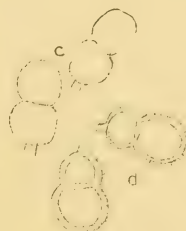
70μ

13d



d

14



c

d

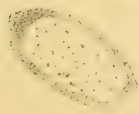


b



$34 \times 15 \mu$

10a



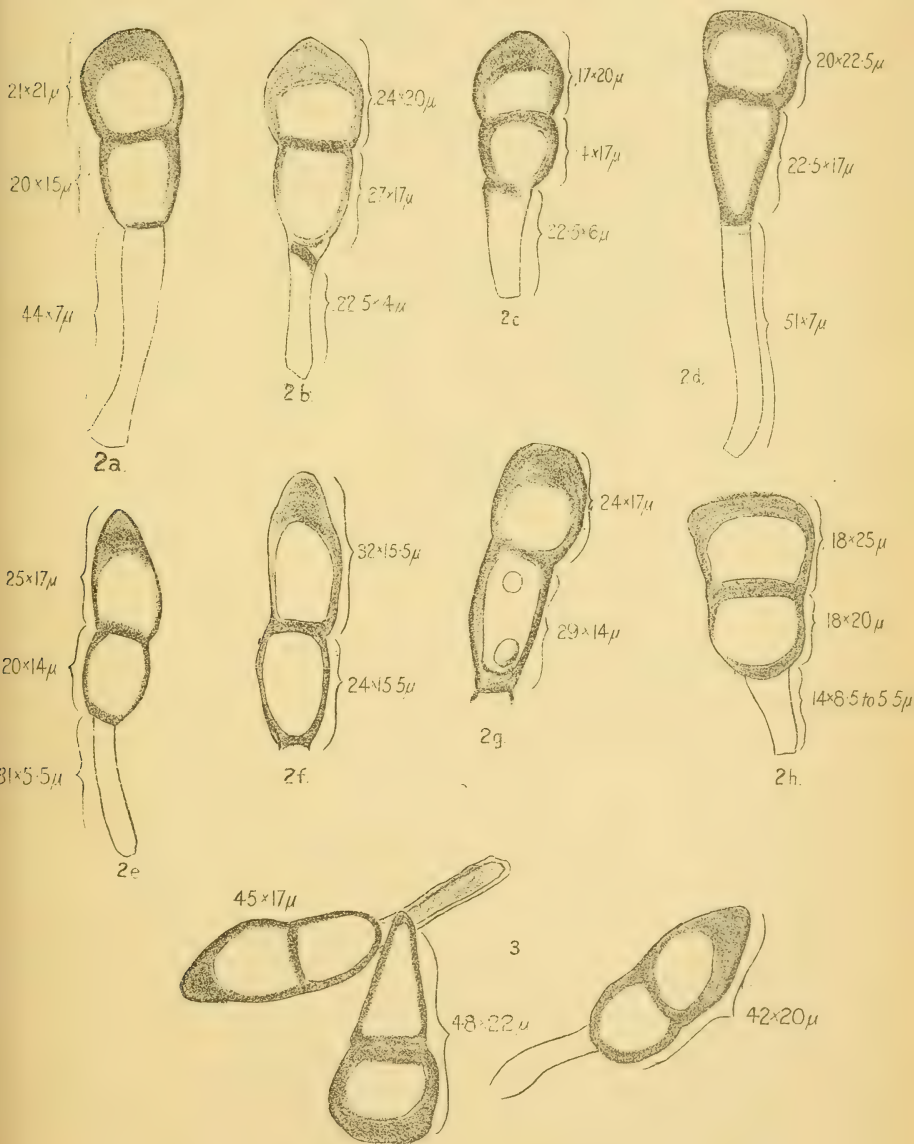
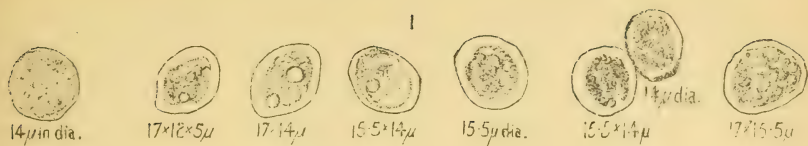
$31 \times 15 \mu$

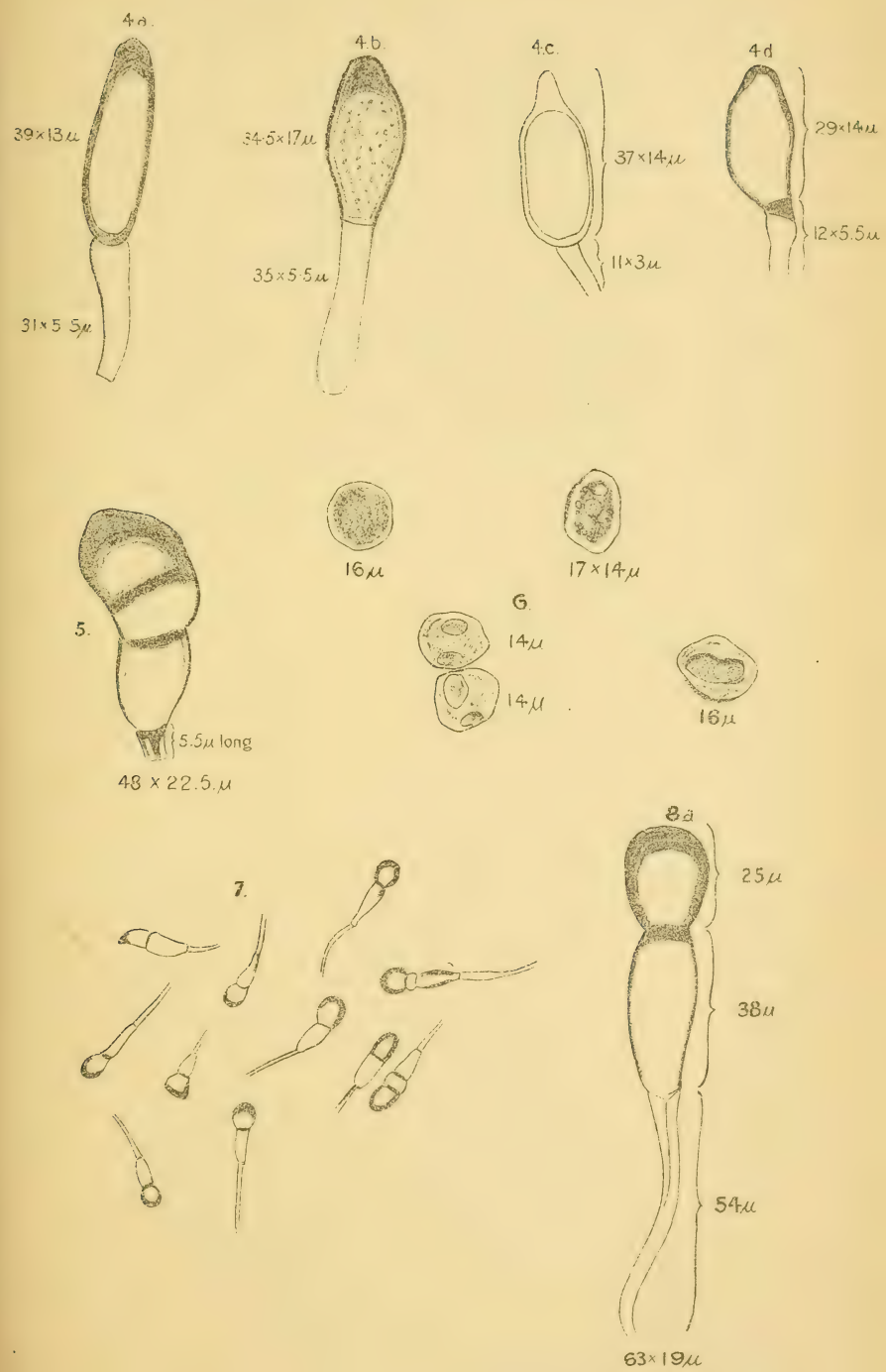


$31 \times 14 \mu$

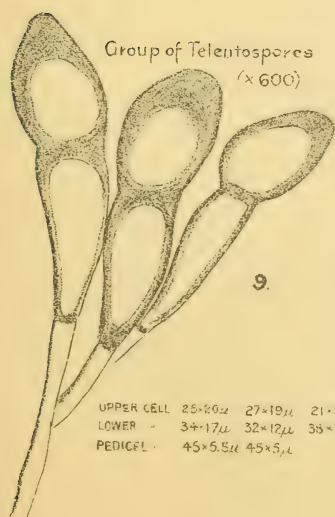
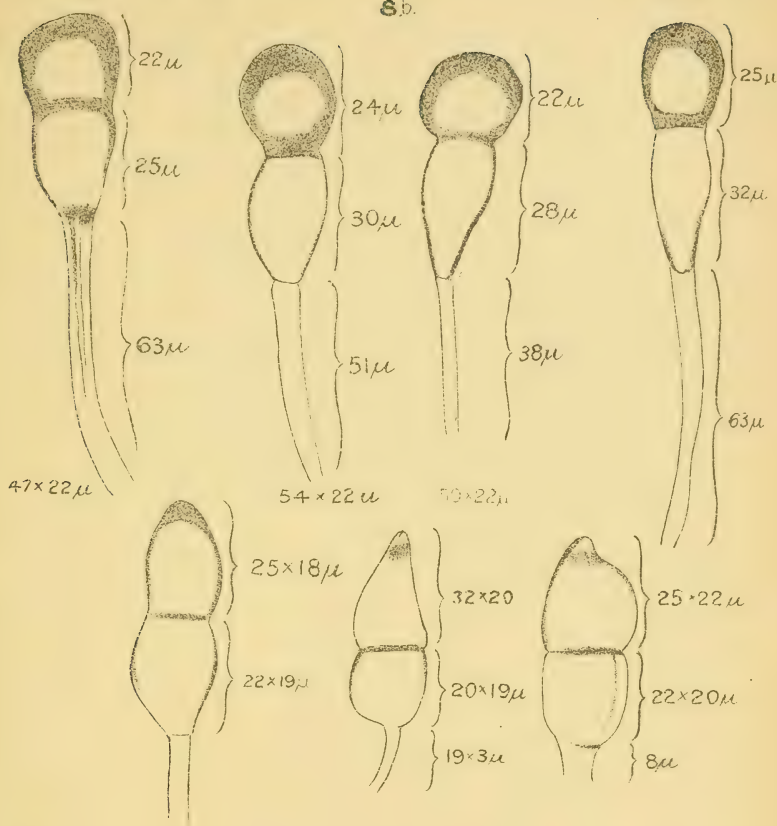


$26 \times 17 \mu$

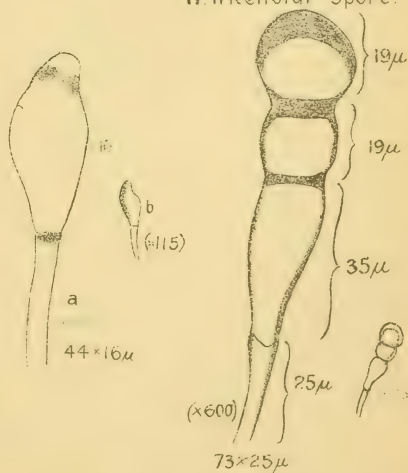


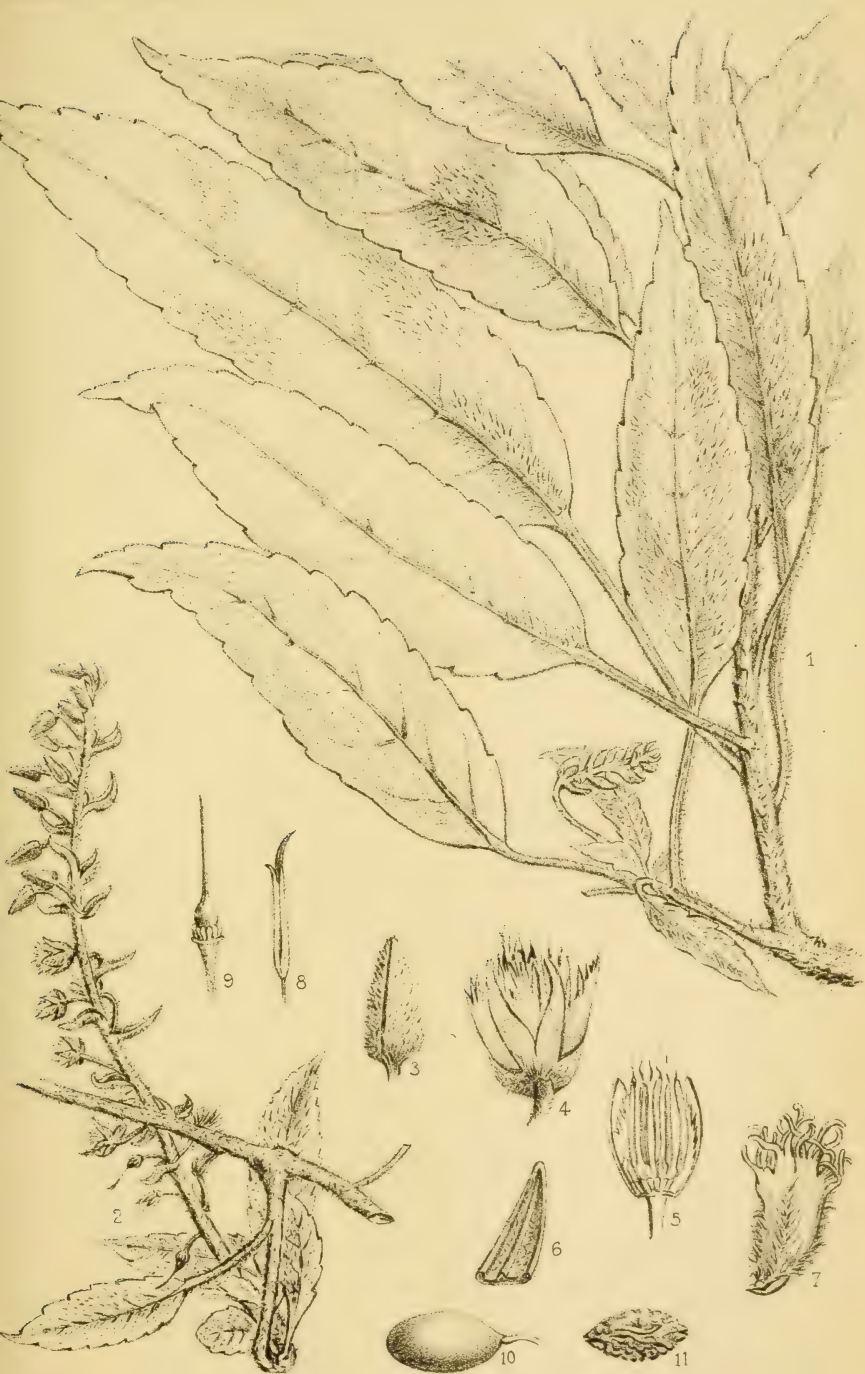


s.b.

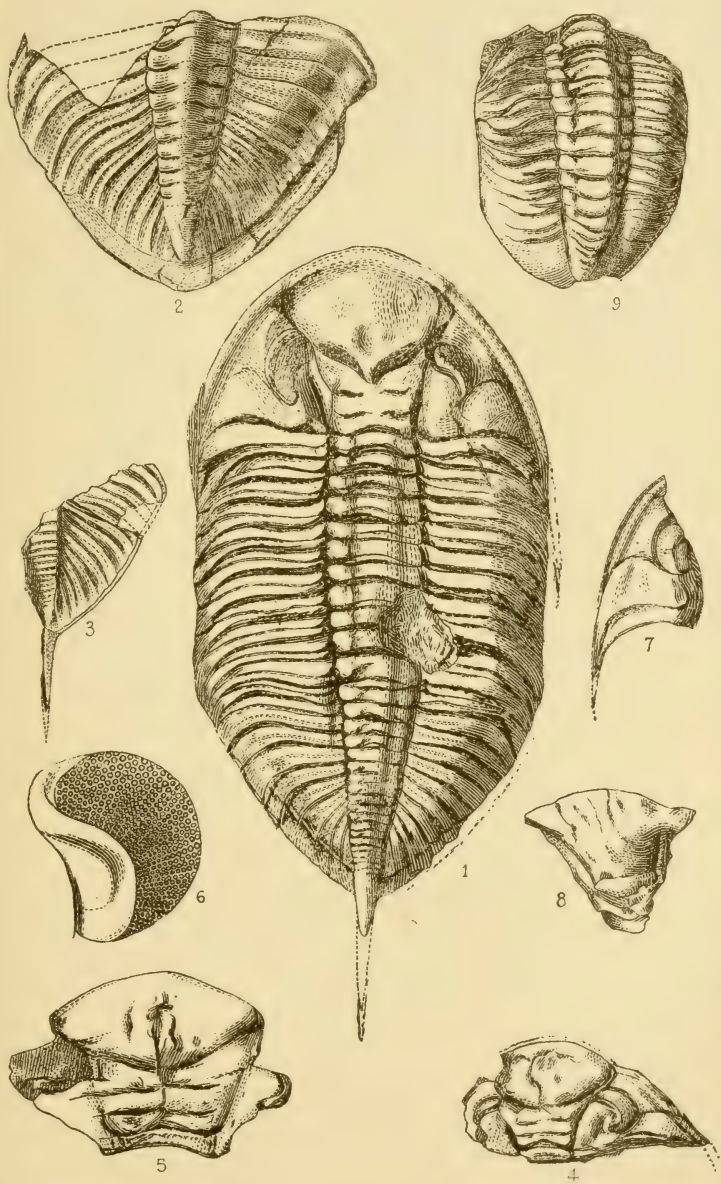


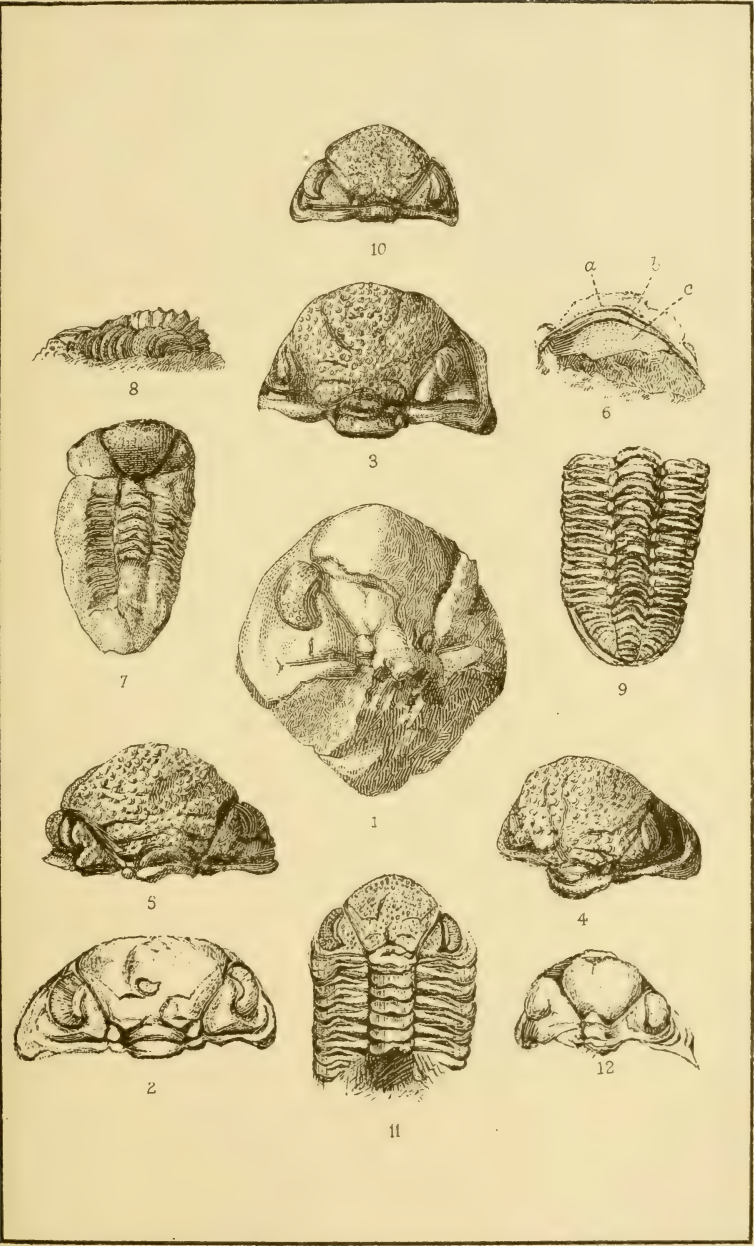
II. Tricellular Spore.

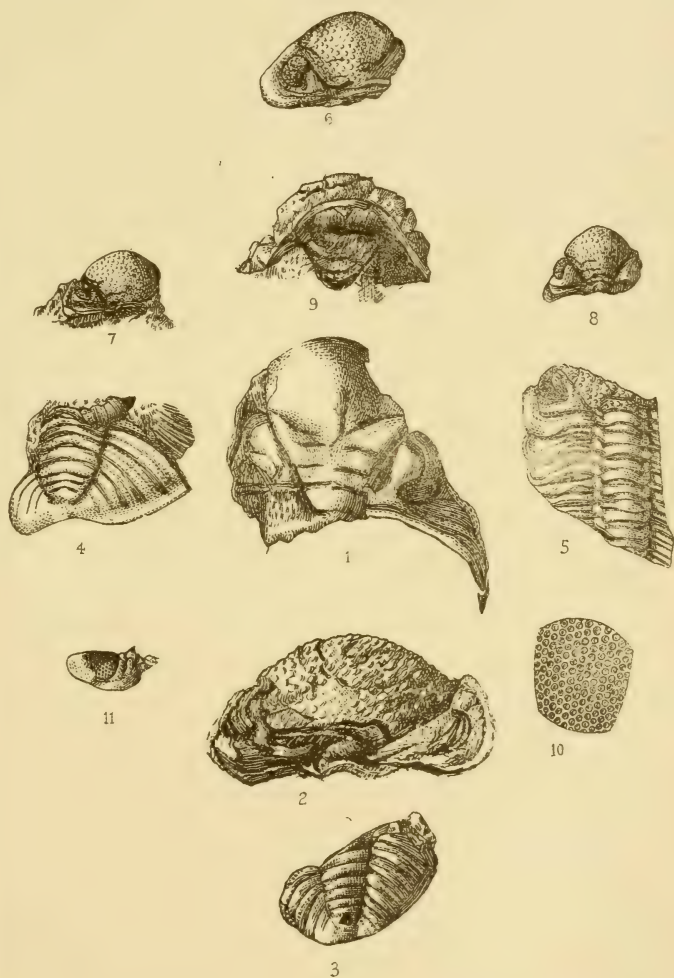


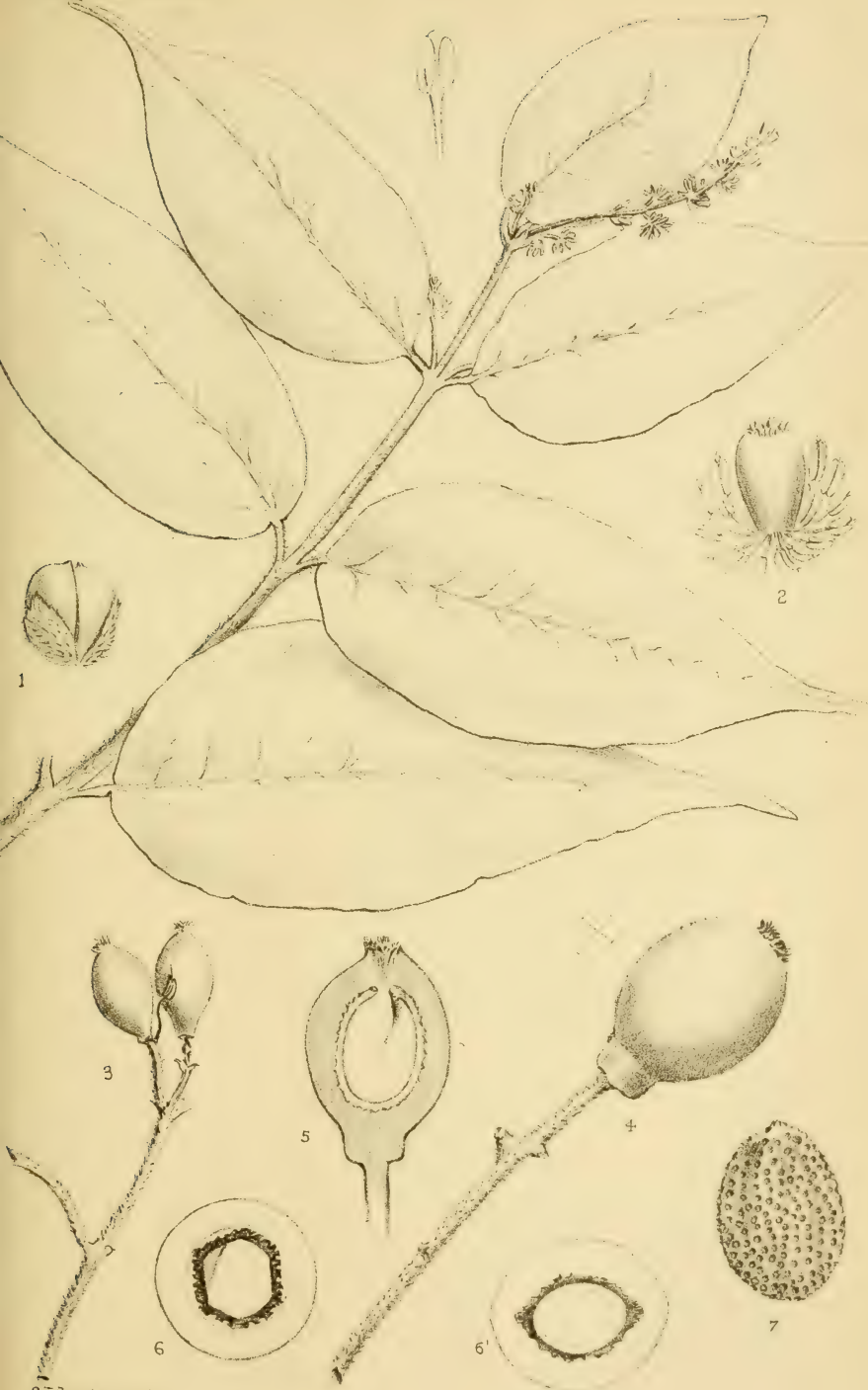


R.T.B. del. ad nat.









RT.B del. ad nat

PIPTOCALYX MOOREI OLIV.



RT.B. del. ad nat.

CRYPTOCARYA MICRONEURA, MEISSN.

Mr. Edgar R. Waite exhibited a number of photographs of Tree Kangaroos (*Dendrolagus bennettianus*, De Vis), at present living in the Melbourne Zoological Gardens, sent by Mr. D. le Souëf. Some of the kangaroos are sitting on the topmost branches of the trees, which have been defoliated even to the extreme tips of the branches. Other photographs show the animals on the ground in truly macropine positions; but one in which the kangaroo is on "all fours" indicates that the fore limbs are probably being more freely used in terrestrial progression than usual.



WEDNESDAY, SEPTEMBER 25TH, 1895.

The Ordinary Monthly Meeting of the Society was held at the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, September 25th, 1895.

The President, Mr. Henry Deane, M.A., M.I.C.E., in the Chair.

DONATIONS

Pharmaceutical Journal of Australasia. Vol viii. No. 8 (Aug. 1895). *From the Editor.*

Royal University of Upsala:—(a) Bulletin of the Geological Institution. Vol. i. (two Parts), Vol. ii. Part 1 (1892-94): (b) Arsskrift, Matematik och Naturvetenskap, 1870, 1, 3: 1872, 1: 1873, 2: 1874, 2: 1875, 1, 4, 5: 1878, 1: 1892, Program 1: (c) Vega-Expeditionens Vetenskapliga Arbeten—Eight Botanical and Zoological Excerpts from Bd. i-iv. (1882-85): (d) Meddelanden från Ups. Univers. Mineralogisk-Geologiska Institution. Nos. 1-10 and 12-13 (8vo. 1891-94): (e) Sveriges Geologiska Undersökning. Ser. C. Afhandlingar. Nos. 60, 76, 78, 88, 95: (f) Ten Inaugural Dissertations, 8vo. (1872-95): (g) Eight Inaugural Dissertations, 4to. (1885-92): (h) Thirty-six Miscellaneous Pamphlets, 8vo. and 4to. *From the University.*

Department of Mines, Victoria—Progress Report. No. viii (1894) and Twelve Special Reports (1892-95). *From the Secretary for Mines.*

Department of Agriculture, Brisbane — Bulletin. Second Series, Nos. 6-7 (1895): Botany Bulletin. No. xi. (1895). *From the Secretary for Agriculture.*

K.K. Zoologisch-botanische Gesellschaft in Wien—Verhandlungen. Bd. xlv. Heft 6. *From the Society.*

Zoologischer Anzeiger. xviii. Jahrgang (1895). Nos. 480-482 (July 22nd-Aug. 19th). *From the Editor.*

Perak Government Gazette. Vol. viii. Nos. 20-21 (Aug. 1895). *From the Government Secretary.*

Bombay Natural History Society—Journal. Vol. ix. No. 4 (1895). *From the Society.*

Société des Sciences de Finlande—Observations Météorologiques, 1889-90, and 1893 (Vol. xii. Liv. 2). [Two Parts.] *From the Society.*

Geological Society, London—Quarterly Journal. Vol. li. Part 3 (No. 203, Aug. 1895). *From the Society.*

Museo di Zoologia, &c., della R. Università di Torino—Bulletin. Vol. x. Nos. 193-209. *From the Museum.*

Royal Geographical Society of Australasia—Queensland Branch—Proceedings and Transactions. Vol. x. (1894-95). *From the Society.*

Department of Agriculture, Sydney—Agricultural Gazette of N.S.W. Vol. vi. Part 8 (Aug. 1895); Cooke's "Handbook of Australian Fungi" (8vo. 1892). *From the Hon. the Minister for Mines and Agriculture.*

Baron von Mueller's "Select Extra-Tropical Plants." Ninth Edition (1895). *From the Premier of Victoria through the Librarian, Public Library, Melbourne.*

Royal Swedish Academy, Stockholm—Oefversigt. Vol. li. (1894): Hj. Theel's "Oem Sveriges zoologiska hafsstation Kristineberg" (8vo. 1895). *From the Academy.*

Indian Museum—Notes. Vol. iii. Nos. 4-5 (1894-5): Pamphlet entitled "Description of a New Species of Oxyrhynch Crab." By A. Alcock, M.B. (1895). *From the Superintendent.*

Bureau of Agriculture, West Australia—Journal. Vol. ii. Nos. 18-19 (Aug.-Sept. 1895). *From the Secretary.*

Société Impériale des Naturalistes de Moscou—Bulletin. Année 1895. No. 1. *From the Society.*

Victorian Naturalist. Vol. xii. No. 5 (Aug. 1895). *From the Field Naturalists' Club of Victoria.*

American Naturalist. Vol. xxix. (1895), No. 344 (Aug.) *From the Editors.*

Harvard College, Cambridge, Mass.—Bulletin of the Museum of Comparative Zoology. Vol. xxviii. No. 1. *From the Curator.*

Connecticut Academy of Arts and Sciences—Transactions. Vol. ix. Part 2 (1895). *From the Academy.*

American Geographical Society—Bulletin. Vol. xxvii. Part 2. *From the Society.*

Department of Lands and Survey, New Zealand—Report for the Year 1894-95. *From H. Farquhar, Esq.*

Konink. Naturkund. Vereeniging in Nederl.-Indië—Naturkundig Tijdschrift. Deel liv. (1895). *From the Society.*

Société Entomologique de France—Annales. Année 1893 (Vol. lxxvii.). *From the Society.*

Journal de Conchyliologie. Vol. xli. (3^e. Sér. T. xxxiii., 1893). *From the Editor.*

Faculté des Sciences de Marseille—Annales. T. iv. Fasc. 1-3: Annales de l'Institut Botanico-Géologique de Marseille. Vol. i. (1893). *From the Society.*

Société des Sciences de l'Ouest de la France—Bulletin. T. iv. 2^{er}-4^e Trim. : T. v. 1^{er} Trim. *From the Society.*

Société Linnéenne de Normandie—Bulletin. 4^e Série. Vol. vii. (1893). *From the Society.*

Asiatic Society of Bengal—Journal. Vol. lxiii. Part i. Title-Page and Index : Vol. lxiv. Part i. No. 1 : Vol. lxiv. Part ii. No. 2 : Proceedings 1895. Nos. 4-6 (Ap.-June). *From the Society.*

Conchological Society of Great Britain and Ireland—Journal of Conchology. Vol. viii. No. 3 (July, 1895). *From the Society.*

Australian Museum, Sydney—Records. Vol. ii. No. 6 (Sept. 1895). *From the Trustees.*

Australasian Journal of Pharmacy. Vol. x. No. 117 (Sept. 1895). *From the Editor.*

British Museum (Nat. Hist.)—Catalogue of Fishes, 2nd Edition. Vol. i. By G. A. Boulenger, F.R.S. (1895) : Catalogue of the Spiders of Burma. By T. Thorell (1895). *From the Trustees.*

Royal Society, London—Proceedings. Vol. lvii. Nos. 347-348. *From the Society.*

NOTES ON *CICADAS*.

BY WALTER W. FROGGATT.

Regularly every season as the warm summer days set in, toward the latter part of the year, the shrill call of the Cicadas, or "locusts" as they are popularly called, is heard with monotonous regularity in every cluster of trees or shrubs about Sydney. It is noticeable that every third year they appear in much greater numbers than in the two preceding seasons; and with the well known fact before us that the American "Seventeen-year Cicada" (*C. septemdecim*) reappears every seventeenth year, I am led to the conclusion that several of our larger species take three years to reach maturity.

During this last season (1894-5) they appeared in countless numbers all round the neighbourhood of Sydney, and were much more in evidence about the suburbs than they had been for many years previously. The paddocks about Croydon were literally covered with the tubular holes through which the pupæ had escaped, while every tree trunk and fence was festooned with the dry larval skins split down the middle of the back and firmly fixed in position by the powerful claws of the fore legs. For fully three months they kept up one continuous screech, unless a thunder storm sprang up, and then every Cicada was mute. Acting on a suggestion made by Dr. Cox at one of our meetings some time ago [Proceedings iii. (2), p. 1508], I jotted down a number of observations made in the bush under these very favourable circumstances, of which the following notes are the result.

At Croydon the first Cicada was heard on the 30th of October about sunset, and a few days later I caught several of the small black ones (*Melampsalta melanopygia*, Ger.). In February their dead bodies began to be plentiful under the trees, and the calls of the survivors were fitful and irregular, according to the state of the weather, being heard only on fine days. The last heard at

Croydon were calling upon the 14th of March, but a single one was recorded from Rose Bay on the 29th of the same month.

In "Insect Life," [Vol. iv. (1892), p. 248], Riley gives an account of the "digger wasp," *Sphecius speciosus*, which stores its nest with one of the common American Cicadas. As I had heard that wasps had been seen killing Cicadas here, I kept a look out for them. During the height of the "locust season" I frequently saw the large yellow sand wasp, *Priocnemus bicolor*, Smith, hunting over the stems of the trees frequented by the Cicadas, which generally flew away with a great clatter without my being able to see what had happened. Eventually I saw the whole business; a hornet flew up, caught by the leg a Cicada engaged in sucking up sap, and shook it until it withdrew its style and flew away. The hornet then stood over the spot and eagerly sipped up the sap as it exuded from the puncture made by the Cicada's style. I afterwards saw the same performance on several occasions, the hornet apparently never hurting the Cicada.

As a general rule the Cicadas prefer the trunks and stout branches to the young twigs and foliage, for with their long and powerful sucking mouth they can perforate the bark and obtain a plentiful supply of nourishment where the flow of sap is most abundant.

Several accounts have been recently published about the curious miniature cities built by the pupæ of some of the American Cicadas. The pupæ (for some reason as yet unsatisfactorily explained) come up to the surface before they are ready to emerge, and form a hollow dome of clay of from two to four inches in height above their tubular shaft about a foot in depth; to the bottom of this they again retreat, after adding this superstructure, until they are ready to cast their pupal garments.

Very little is known about the habits of the larvæ and pupæ of any of our species, most of them coming straight up from a considerable distance below the surface when ready to emerge; but I have upon several occasions found a single pupa under stones; such were always enclosed in a stout clay cell at the base of which was a small reservoir of water.

I am indebted to Mr. W. F. Kirby, of the British Museum, for the identification of most of my species.

THOPHA SACCATA, Amyot ("The Double Drummer").

This is our largest species, measuring $5\frac{1}{2}$ inches across the wings from tip to tip; the body $9\frac{1}{2}$ lines across the shoulders, and lower down upon the large males at the drums an inch; the abdomen short and rounded in the males, and coming to a sharp point in the females. Wings hyaline and unspotted, the nervures pinkish-brown with the costal lower one marked with black. General colour fulvus-brown, with the centre of the thorax marked with transverse angular black stripes, and the basal part of all the the abdominal segments also black.

From the way in which his musical apparatus projects this Cicada is called the "Double Drummer" by the Sydney boys; and the female without this development is called the "Single Drummer." This species attracts one's notice in the middle of November; and increases in numbers until the middle of January. They were not so common about the gardens, but on North Shore and about Manly seemed to prefer the clumps of small stunted gums (*E. corymbosa*, *E. robusta*, and *E. resinifera*), clinging to the stems, and flying off at the least sound. Their cry is a loud harsh note drawn out and shrill; when singing they do not move their bodies, but droop their wings down on either side.

CYCLOCHILA AUSTRALASIÆ, Amyot ("The Green Monday").

Expanse of wings 5 inches, width across the shoulders 9 lines, length of body 3 inches. Wings hyaline, unspotted; nervures bright green, the base of the large nervures near the shoulder yellow tinted with carmine. The whole of the insect pale grass-green, but changing to a much duller colour after death.

This is our commonest Sydney Cicada, which is found in greater or less numbers every season. The first was taken about the 3rd of November, and by the 13th all the trees in the gardens were covered with them; where there were no Eucalypts, they showed a

marked preference for the *Pittosporum* trees. Though I caught numbers, I could obtain no females until the 24th of November, three weeks after the first males appeared, but after that date they were nearly as plentiful as the other sex.

There is a yellow variety of this species, which is popularly called the "Yellow Monday;" the only difference that I can find is in the colour, but they are nothing like as common as the green one.

MACROUISTRIA ANGULARIS, Germ. ("The Union Jack").

Expanse of wings 5 inches, width of shoulders 9 lines, length of body $1\frac{3}{4}$ inches. Wings hyaline, the nervures pale ochreous-yellow, close to the shoulders reddish-brown, the nervures forming the lower marginal cells of the hind wings with a fine pencilled line of black on both sides, giving the wings a slightly mottled appearance. General colour of the insect black, with the front of the head, mesothoracic band, and the apex of the metathorax dark ferruginous; three patches in a line between the eyes with another behind them, a row of three elongate spots in the centre of the prothorax, and a row of four slender transverse spots along the middle of the metathorax pale ochreous-yellow; colour of the ventral surface ferruginous mottled with black; in the males the drums are rather small and do not project on the sides.

This Cicada does not appear about Sydney every year, but during this last season it was comparatively numerous; it is never found about the gardens, but I found it more numerous where the smooth-stemmed gums (*Eucalyptus sieberiana* and *E. haemastoma*) were common, generally upon the main trunk.

PSALTODA MCERENS, Germ. ("The Floury Miller").

Expanse of wings $4\frac{1}{2}$ inches, width of shoulders 8 lines, length of body $1\frac{1}{2}$ inches. Wings hyaline, nervures of the fore wings black, with the edges of several forming a W near the tip of the fore wing, and those forming the apex and sides of the lower row of cells edged on either side with black, giving them a thickened

appearance; the nervures of the hind wings horn-brown, with the apex of the lower row of cells towards the tip deeply shaded with black, fading out towards the middle of the wing.

The whole of the insect is black on the upper surface, but covered with fine silvery white hairs which form little white spots here and there, looking as though it had been dusted with flour. From this circumstance it has received from the Sydney children the rather appropriate name of the "Floury Miller."

None of this species were seen about Sydney until the commencement of December. They are rarely found in gardens, preferring the Eucalypts; at Manly on the 7th of December they were very numerous upon the smooth stems of the apple tree gums (*Angophora lanceolata*); upon one small limb not more than a foot in diameter I counted 49, and all the trees in the gully were covered with them.

When singing they sit close against the stem, elevating the tip of the abdomen and jerking it up and down while the song continues; their note is sharp and shrill, but more musical than any of the other species. When sucking up the sap they flatten the body against the branch, burying the rostrum right up to the head, it being long enough to penetrate the stout bark and reach the inner side. They remained in considerable numbers until early in January, when they began to be scarce.

PSALTODA FLAVESCENS, Dist. ("The Mottled Grey").

Expanse of wings $4\frac{1}{2}$ inches, width across the shoulders 7 lines, length of body 16 lines. Wings hyaline, nervures brown, but mottled with black, which extends over on either side, forming three irregular bands across the wings, the nervures of the hind wings brown. Ground colour of this Cicada black, thickly mottled with chocolate brown and ferruginous red, the former forming a slender parallel bar across the centre and a band along the apical margin of the prothorax, a W-like mark in the centre, a stripe on the sides of the mesothorax, and the edges of the metathorax and scutellum pale brown, the ferruginous tints

mottling the head and thorax and marbling the segments of the abdomen, the head behind the eyes and the abdomen frosted with silvery pubescence; ventral surface grey except the abdomen which is black, and the covers of the drums which are reddish-pink, flat and placed behind the hind legs.

I am told by some of my young friends that this is called the "Mottled Grey," but do not think that the name is in general use. I had never seen more than half-a-dozen specimens of this species until last year, when they appeared in considerable numbers, but chiefly in the neighbourhood of Hurstville and Sutherland; a few were taken about Middle Harbour and others at Granville.

MELAMPSALTA MELANOPYGIA, Germ.

Expanse of wings 2 inches, width across the shoulders 3 lines, length of body 10 lines. Wings hyaline, costal nervure of both wings and the two inner nervures of the hind ones yellowish-brown edged with black on both sides, all the others black. Head and thorax chestnut brown mottled with black and clothed with fine white hairs scattered over the dorsal surface, but much closer upon the legs and undersurface; legs chestnut striped with black, the scutellum small, forming four angular star-like ribs, the abdomen at the base and along the summit black, the sides, tip and undersurface golden yellow, lightly clothed with fine hairs.

This is the first Cicada to appear about Sydney, the earliest specimens being taken on the last day of October at Hornsby. They are very active little fellows, flying about and clinging to the stems of the young Eucalypts, calling with a sharp whirring note all the time. I have taken a few of these every season about Hornsby and Middle Harbour, but they do not last long, disappearing in a few weeks.

MELAMPSALTA ENCAUSTICA, Germ.

Expanse of wing $1\frac{3}{4}$ inches, width across the shoulders 3 lines, length of body 8 lines. Wings slightly opaque, all the larger nervures brown lined on either side with black, all the smaller

ones black. Head and thorax black, with a spot behind the ocelli, a parallel line down the centre of the prothorax, and two similar ones crossing the mesothorax light brown; the ridges of the scutellum of a similar colour but tinged with pink, with several other pink marks above the antennæ and sides of the thorax; abdominal segments black, with a narrow apical transverse band of pale yellow, extending right round, the tip bright yellow; legs variegated with black and white, striped with pinkish-yellow.

This is one of our smallest species, seeming to take the place of the preceding species in the Shoalhaven district.

Three other fine species not yet determined were also taken, but as far as I know are very rare, only a pair of each having been found during the last three seasons.

TIBICINA sp. A handsome dark chestnut-brown insect measuring $3\frac{1}{2}$ inches across the wings, with two black spots towards the tips of the forewings, and the sides of the thorax and abdomen clothed with fine white hairs, very thick upon the latter, the costal nervure of the forewings also mottled with similar pubescence.

PSALTODA sp. A large black Cicada with an expanse of 4 inches across the wings, the nervures being tinted with reddish-brown; the male has a large patch of bright golden hairs on the sides of the third segment of the abdomen, absent in the female.

PSALTODA sp. A slightly smaller insect, similar in general colouration, but the blotch upon the side of the abdomen of a bright silvery colour.

ON THE DATES OF PUBLICATION OF THE EARLY VOLUMES OF THE SOCIETY'S PROCEEDINGS.

BY J. J. FLETCHER.

The first twenty-eight Parts of the Society's Proceedings—constituting Vols. i.-vii. of the First Series (for the years 1875-1882)—offer no more definite indication of the several dates of publication than is afforded by a notice of the year of issue at the foot of the front page of the paper covers, or on the title-page included in the fourth and concluding Part of each Volume. Unless specially instructed to the contrary, bookbinders seem habitually to discard the covers when binding. A number of copies of Vols. i.-iv., bound at Sir W. Macleay's expense, so treated, have passed into circulation under the Society's auspices. In regard to these, and others so dealt with, it should be borne in mind that the year indicated on the title-page is usually that in which the fourth and last Part only of the Volume was issued: or if not so, the coincidence is accidental.

The first twenty-six of the Parts in question were issued prior to the Garden Palace Fire. As the Society's official books and records were completely destroyed therein, no information whatever about these early Parts is forthcoming from this source. Eleven consecutive Parts commencing with Part 2 of Vol. i., were printed by two firms which subsequently retired altogether from business, the establishment of one of them having been completely burnt out; so that no particulars from the publishers are obtainable, and I have only the dates of receipt kindly supplied by the Librarians of the Public Library and Royal Society of N. S. Wales to go by.

Occasionally there arise questions of priority in the description of species dealt with in these Volumes; and requests for authoritative information as to dates of publication are from time to time received.

It seemed advisable, therefore, that the effort should be made, once for all, to ascertain if possible the dates of publication of the first twenty-six Parts with a view to their publication. On applying to the Librarians of the Public Library, Sydney, and the Royal Society of New South Wales, I was most kindly furnished with almost complete lists of the dates of their receipt of the various Parts—which are approximately those of publication. Messrs. F. Cunninghame & Co., who printed Part 1, very obligingly referred to their books, and supplied the requisite information about this Part. Mr. F. White, who printed Vols. iv.-vii., most courteously provided me with a list of the dates of delivery to the Society of the sixteen Parts comprised in these Volumes. From the data so supplied, the list—as approximately correct as it is now possible to make it—given overleaf has been compiled.

One or two other matters may also be noted.

The first Volume is exceptional in that it comprises the Proceedings of two years—Part 1 constitutes the Proceedings for 1875: Parts 2-4 the Proceedings for 1876. In the separate copies of Part 1 as issued, was inserted a slip—which is missing in all the bound Volumes I have seen—setting forth that—

“The first 20 pages of this Part were printed and circulated ten months ago. They have now been re-printed in order to make the Part complete.”

The sixteen consecutive Parts, commencing with Vol. viii., and ending with Vol. i. (Second Series), have the dates of issue on the paper covers, but there only. If the covers have not been preserved in binding all clue to dates is lost in bound volumes. They are accordingly included in the list.

Commencing with Vol. ii. (Second Series), not only is the date given on the cover of each Part, but it is repeated at the head of the lists of the Contents of the four Parts comprised in each Volume, supplied along with the title-page and Index in the concluding Part thereof. No room for doubt, therefore, can arise in connection with these and future Parts :—

First Series.

Vol. i. Part 1 (pp. 1-20 only)—Issued April 27th		1875.
1 (pp. 1-96)	„ *February	1876.
2 (pp. 97-168)	„ *July	1876.
3 (pp. 169-282)	„ *February	1877.
4 (pp. 283-419)	„ *March	1877.
Vol. ii. Part 1 (pp. 1-122)	„ *July	1877.
2 (pp. 123-217)	„ *January	1878.
3 (pp. 218-288)	„ *May	1878.
4 (pp. 289-401)	„ *June	1878.
Vol. iii. Part 1 (pp. 1-76)	„ *September	1878.
2 (pp. 77-161)	„ *December	1878.
3 (pp. 161-305)	[No data]	
4 (pp. 306-443)	„ *May	1879.
Vol. iv. Part 1 (pp. 1-116)	„ June 16th	1879.
2 (pp. 117-244)	„ October 6th	1879.
3 (pp. 245-387)	„ December 1st	1879.
4 (pp. 387-492)	„ May	1880.
Vol. v. Part 1 (pp. 1-105)	„ August	1880.
2 (pp. 106-272)	„ November 22nd	1880.
3 (pp. 272-458)	„ February	1881.
4 (pp. 459-652)	„ May 20th	1881.
Vol. vi. Part 1 (pp. 1-170)	„ July	1881.
2 (pp. 170-408)	„ September 12th	1881.
3 (pp. 409-711)	„ December	1881.
4 (pp. 712-872)	„ March 20th	1882.
Vol. vii. Part 1 (pp. 1-135)	„ May 23rd	1882.
2 (pp. 135-304)	„ August	1882.
3 (pp. 303-404)	„ October 28th	1882.
4 (pp. 405-684)	„ April	1883.

* Dates of receipt, or more correctly, dates of registration. As at this time the publications do not seem to have been always delivered as punctually as they are now, it is not improbable that some of the dates given are really as much as one month or even longer behind time.

Vol. viii. Part 1 (pp. 1-180)	—Issued June 19th	1883.
2 (pp. 181-298)	„ July 17th	1883.
3 (pp. 299-417)	„ October 19th	1883.
4 (pp. 419-583)	„ February 21st	1884.
Vol. ix. Part 1 (pp. 1-181)	„ May 23rd	1884.
2 (pp. 183-443)	„ August 19th	1884.
3 (pp. 445-866)	„ November 29th	1884.
4 (pp. 867-1242)	„ March 4th	1885.
Vol. x. Part 1 (pp. 1-126)	„ June 4th	1885.
2 (pp. 127-279)	„ July 31st	1885.
3 (pp. 279-554)	„ December 21st	1885.
4 (pp. 555-881)	„ April 3rd	1886.

Second Series.

Vol. i. Part 1 (pp. 1-238)	—Issued May 25th	1886.
2 (pp. 239-578)	„ August 23rd	1886.
3 (pp. 579-975)	„ November 17th	1886.
4 (pp. 975-1237)	„ February 22nd	1887.

DESCRIPTION OF A TREE CREEPER PRESUMABLY
NEW.

BY C. W. DE VIS, M.A., CORR. MEM.

Unknown to the author, the same species had been shortly before described by Mr. North in the *Ibis* (July, 1895). The paper was therefore withdrawn.

NOTES AND EXHIBITS.

The President exhibited a number of botanical specimens from the Tweed River, including fruiting examples of *Elaeocarpus grandis*, F.v.M., locally known as the Blue Fig or Quandong, an interesting slender variety of *Pteris tremula*, *Aspidium tenerum*, *Adiantum aethiopicum*, and other ferns at present undetermined. Also *Gleichenia dichotoma*, Hk., from the Hawkesbury River; cones of *Sequoia gigantea*; and an undetermined *Banksia* which needs investigation.

Mr. Froggatt exhibited his collection of Sydney Cicadas.

Mr. Steel showed a Gecko (*Gehyra vorax*, Gir.) from the Rewa River, Fiji. He also remarked that the animal when alive is extremely flaccid, as if it had no bones; it is also apparently to some extent vegetarian in its diet, portions of leaves of the sugar cane as well as of an undetermined plant having been found in the stomach of a specimen dissected.

Mr. Fletcher showed some English humble bees, the defunct portion of a consignment from New Zealand recently brought over by the Department of Agriculture in the hope of the successful acclimatisation of the insects. Of the survivors some were liberated in the Botanic Gardens, and some in the Society's garden. As the bees were set free just after the first of the recent rains, they should have a fair chance of doing well; and any information about their subsequent movements and operations would be welcome.

WEDNESDAY, OCTOBER 30TH, 1895.

The Ordinary Monthly Meeting of the Society was held at the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, October 30th, 1895.

The President, Mr. Henry Deane, M.A., M.I.C.E., in the Chair.

Miss Mary Lodder, Ulverston, Tasmania, was elected an Associate Member of the Society.

DONATIONS.

Geological Survey of India—Records. Vol. xxviii. Part 3 (1895). *From the Director.*

Six Pamphlets on Hymenoptera. By M. C. Janet. *From the Author.*

Pharmaceutical Journal of Australasia. Vol. viii. Nos. 9-10 (Sept.-Oct., 1895). *From the Editor.*

Pamphlet entitled "Phthisis in New South Wales and other Australasian Colonies." By G. L. Mullins, M.A., M.D. *From the Author.*

Bureau of Agriculture, Perth, W.A.—Journal. Vol. ii. Nos. 20-21 (Sept.-Oct., 1895). *From the Secretary.*

Zoological Society of London—Proceedings, 1895, Part ii. *From the Society.*

Perak Government Gazette. Vol. viii. Nos. 22-23 (Aug.-Sept.).
From the Government Secretary.

Royal Microscopical Society—Journal, 1895. Part 4 (Aug.).
From the Society.

Société des Sciences de Finlande—Acta. T. xx. (1895):
Bidrag till Kännedom af Finlands Natur och Folk. 54-56 Häftet:
Oefversigt. T. xxxvi. (1893-94). *From the Society.*

Société d'Horticulture du Doubs, Besançon—Bulletin. n.s.
No. 56 (Aug., 1895). *From the Society.*

Zoologischer Anzeiger. xviii. Jahrg. Nos. 483-484 (Sept.,
1895). *From the Editor.*

K. K. Zoologisch-botanische Gesellschaft in Wien—Verhand-
lungen. Bd. xlv., Heft 7 (1895). *From the Society.*

Manchester Museum, Owens College—Studies from the Biolo-
gical Laboratories. Vols. i.-ii. (1886-90): Catalogue of the
Library (1895): Handy Guide to the Museum (1895): Report,
1890-94. *From the Museum.*

Victorian Naturalist. Vol. xii. No. 6 (Sept., 1895). *From
the Field Naturalists' Club of Victoria.*

American Naturalist. Vol. xxix. No. 345 (Sept., 1895).
From the Editors.

Pamphlet entitled "Remarks on *Daimonelix*," &c. (From the
American Geologist. xv.) By J. F. James, M.Sc. *From the
Author.*

U.S. Department of Agriculture—Division of Entomology—
Insect Life. Vol. vii. No. 5 (1895): Technical Series. No. 1.
"Aphelininae of N. America." *From the Secretary of Agriculture.*

American Museum of Nat. Hist.—Bulletin. Vol. vii. (1895).
Sig. 17 (pp. 257-272). *From the Museum.*

Department of Mines, Sydney—Memoirs. Palæontology, No.
9 (1895). *From the Hon. the Minister for Mines.*

Marine Biological Association, Plymouth—Journal. n.s. Vol. iii. No. 5 (Extra No.): Vol. iv. No. 1 (Sept., 1895). *From the Director.*

Revista de Sciencias Naturaes e Sociaes. Vol. iv. No. 13 (1895). *From the Editor.*

Science Gossip. 58 Nos. (1890-95): British Naturalist. 23 Nos.: Phipson's "Phosphorescence": Catalogue of the Library of the Linnean Society. Parts i.-iii.: and Thirty-three Miscellaneous Pamphlets. *From C. T. Musson, Esq., F.L.S.*

Linnean Society of London—Transactions. Second Series. Botany. Vol. iv. Part 2; Vol. v. Part 1 (1894-95); Zoology. Vol. vi. Part 3 (1894). *From C. Hedley, Esq., F.L.S.*

"Spelunca" (Bulletin de la Société de Spéléologie). T. 1^{er}. No. 1 (Jan.-Mar., 1895): Extrait de L'Annuaire Géologique Universel—Asie et Océanie. Pamphlet entitled "Etude de Géologie sur le Bassin de Paris" (1894). Par G. Ramond. *From Monsieur G. Ramond.*

Department of Agriculture, Brisbane—Botany Bulletin, No. xii (Oct., 1895). *From the Government Botanist.*

Department of Agriculture, Sydney—Agricultural Gazette. Vol. vi. Part 9 (Sept., 1895) *From the Hon. the Minister for Agriculture.*

Australasian Journal of Pharmacy. Vol. x. No. 118 (Oct., 1895). *From the Editor.*

THE GREY GUM OF THE NORTH COAST DISTRICTS.

(Eucalyptus propinqua, sp.nov.)

BY HENRY DEANE, M.A., F.L.S., AND J. H. MAIDEN, F.L.S.

(Plate XLIII.)

The Grey Gum of the North Coast districts has for many years held an uncertain botanical position, having being ranked at different times by botanists under *E. punctata*, *E. saligna*, and even *E. viminalis*. We determined to carefully investigate the tree *de novo*, and we have arrived at the opinion that it will but perpetuate the confusion which has for so many years existed, if it be subordinated to any existing species. From observations in the field and upon dried specimens, we find that it is remarkably constant, and in raising it to specific rank under the name of *Eucalyptus propinqua*, we allude to its affinities with *E. punctata* and *E. saligna*.

The species also bears considerable affinity to *E. resinifera*, not only in regard to the fruits, which are so similar as to be distinguished with difficulty from some of the smaller forms of *E. resinifera*, but also in leaf-venation.

EUCALYPTUS PROPINQUA, sp.nov.

A large, straight growing, cylindrical-stemmed tree, found up to 4 or 5 feet in diameter, and 120 feet and more in height.

Bark.—It has a grey dusty-looking slightly raspy appearance as regards its bark. Next to the Blue or Flooded Gum it is one of the straightest stemmed trees in the forest. The bark darkens, peels off in large longitudinal irregular patches, leaving a smooth white surface, which in course of time darkens, peels off, and the

process is indefinitely repeated. The bark closely resembles, and is perhaps not to be distinguished from, that of *E. punctata*.

Timber.—Dark coloured, and so closely resembling Red Ironbark (*E. siderophloia*) that care is required to distinguish the two timbers. Inclined to have rings or “scabs” of kino, which diminishes the demand for it for sawn stuff. Very durable in or out of the ground, but its tensile strength inferior to that of the Ironbark already referred to.

Seedling leaves.—More broadly lanceolate, and with the marginal vein more distant from the edge, than in the case of the mature leaves. At first opposite.

Mature leaves.—Narrow lanceolate and very uniform. Average length 4-5 inches, breadth $\frac{3}{4}$ inch. Veins not prominent, lateral veins nearly parallel; marginal vein on or very close to the edge of the leaf as a very general rule. Edge usually slightly recurved.

Peduncles flattened.

Calyx-tube hemispherical, and longer than the operculum. Sometimes with the angles of the flattened pedicel decurrent.

Flowers in a marked manner pedicellate; usually in tens, but the umbels containing as few as five flowers.

Operculum hemispherical in general outline, but with a low pointed apex.

Stamens inflexed before expansion, the anthers opening by parallel slits, and all fertile.

Fruit very uniform in size, about $2\frac{1}{2}$ lines broad by $1\frac{1}{2}$ lines deep. Usually 4-celled. Occasionally 3-celled; 5-celled not seen at present. The rim usually shows two sharp edges, with the intervening space concave. The *valves* are well exerted.

The fruits, as regards the rim and general contour, considerably resemble those of the smaller forms of *E. resinifera*, more so than those of *E. punctata*.

Affinities.—The affinities of *E. propinqua* are with *E. saligna* and *E. punctata*, contiguous species in Baron von Mueller's *Census*.

A paper by J. H. Maiden and R. T. Baker in Proc. Linn. Soc. N.S.W. [2], viii., 312, may be here referred to, as the affinity of *E. propinqua* to *E. saligna* is there shown. *E. propinqua* is, in that paper, looked upon as a variety of *E. saligna*.

As regards *E. punctata* and *E. propinqua*, the timber and bark of the two species resemble each other a good deal; they may be, for all practical purposes, identical. They also agree in the flattened peduncles and the stamens (points of resemblance, however, not peculiar to these two species).

Differences.—They differ in the size of the flower-buds and fruits, which in *E. propinqua* are quite small; *E. propinqua* has narrow lanceolate leaves and also has more parallel and less prominent lateral veins than *E. punctata*. The calyx-tube and also the operculum of *E. propinqua* are more distinctly hemispherical and its flowers more pedicellate.

The fruit of *E. punctata*, though variable in size, is always larger and more cylindrical than that of *E. propinqua*.

We are fully aware that *E. punctata*, as at present defined, is a somewhat unsatisfactory species, and it is our intention to fully deal with the matter, in its proper order, in the series of Notes on New South Wales Eucalypts which we will shortly commence to submit to the Society.

Range.—From the Hawkesbury River northwards at least as far as the Tweed River. We have no evidence yet as to whether it extends to Queensland, but it very probably does. Going west it has been found on the eastern slopes of the Dividing Range.

EXPLANATION OF PLATE.

Fig. 1.—Two twigs, showing variation in width of leaves.

Fig. 2.—Part of a leaf, showing venation, and also slight recurving of edge.

Fig. 3.—Vertical section of a bud.

Fig. 4.— „ „ of an expanded flower.

Fig. 5.—Front and back view of anther.

Fig. 6.—Individual fruits.

JOTTINGS FROM THE BIOLOGICAL LABORATORY OF SYDNEY UNIVERSITY.

BY PROF. WILLIAM A. HASWELL, M.A., D.Sc.

NO. 18 — NOTE ON CERTAIN POINTS IN THE ARRANGEMENT AND STRUCTURE OF THE TENTACULIFEROUS LOBES IN *Nautilus* *pompilius*.

(Plate XLVIII.)

In writing a short account of the structure of *Nautilus* for a general work I have had occasion to examine a considerable number of specimens, and in doing so have noticed one or two points to which attention has, I think, not hitherto been directed. The most important of these, with which alone the present communication deals, has to do with the tentaculiferous lobes of the foot, and their sexual modifications.

No fewer than three papers published or read recently deal with sexual differences in *Nautilus*. Two of these, one by Willey,* the other by Vayssière,† refer only to sexual differences in the shell; the third, by J. Graham Kerr,‡ is referred to below.

The tentacles of *Nautilus* are arranged in two series—an outer, and an inner. With the outer series we are not at present concerned. The inner series exhibit a marked sexual difference in their arrangement. In the female this inner series consists of two symmetrical lateral lobes, each bearing twelve tentacles, and of a median (posterior) portion. In the male the two lateral lobes of the inner series are unsymmetrically developed, four of the tentacles of one side, usually the left, being modified to form the structure known as the spadix.

The spadix was first described by Van der Hoeven.§ He calls it “a great conoid body, the length of which was nearly $2\frac{1}{2}$

* Natural Science, June, 1895.

† Comptes Rendus, 24th June, 1895.

‡ Zoological Society of London, Abstract of Proceedings, June 18, 1895.

§ Trans. Zool. Soc., Vol. iv., p 27. The earlier Dutch papers are not accessible to me.

inches; this part was laterally compressed; at its basis its measure from the dorsal to the ventral side was found to be 1 inch, 10 lines; from the right to the left side only 1 inch." He adds "This part was proved to me by dissecting it to be formed by the union of four unusually developed tentacular slips, one of which was shorter and more free, the three other chiefly composing the singular body."

From the dimensions here given and the figures accompanying the paper it would appear that Van der Hoeven had under observation a completely or nearly completely developed specimen. Such mature specimens are comparatively rare; and all the male Nautili that have been made the subjects of other published descriptions appear to have been immature, so that some important and interesting points in the structure of the fully-developed spadix have been overlooked.

In the larger of the two mature male specimens I have had the opportunity of examining (in which the greatest diameter of the shell is $6\frac{1}{2}$ inches) the total length of the organ is $3\frac{1}{4}$ inches, the greatest breadth about $1\frac{1}{3}$ inch, and the thickness a little less than an inch. The four tentacles composing it (Plate xlviii. fig. 1) are all very strongly modified in different directions. One of them, as observed by Van der Hoeven, is separate from the rest except at the base. It is shorter than the others, and does not seem to be capable of being retracted, its sheath being very short: its free part, which is spathulate towards the extremity, lies under shelter of a wide fold extending backwards over it from the sheath of the tentacle which I have numbered 3. Tentacles 2, 3, and 4 have their sheaths united, but the tentacles themselves are quite separate. No. 2 is a thick, solid, muscular cylinder, or rather elongated, blunt cone, probably not capable of being extended to any great distance; the cavity of its sheath is very wide. No. 3 is elongated and laterally compressed, marked on its posterior and external surface with numerous transverse ridges. No. 4 presents the most remarkable modification; it is thick and cylindrical towards the base, becoming compressed towards the free end. The outer

surface (fig. 2) has the appearance of a minute honeycomb, owing to its being covered over with numerous rows of minute apertures, arranged with the greatest regularity.

On the free flap of the 3rd tentacle covering over the 1st, there is to be observed an oval dark patch, which to the naked eye appears minutely tuberculated. When this is examined under a lens (fig. 3) the tubercles are found to be minute elevations, each with a rounded aperture at its summit. Microscopic sections shew the thickened patch to contain numerous branching glands, the ducts of which open at the apertures mentioned. The specimens were not in good order for histological study; but the cells of the glands were found to be full of large rounded granules.

The remaining portion of the inner series (internal labial tentacles of Owen,* labial tentacular lobe of Keferstein†) is fully developed only in the female. It consists of a large flattened median lobe, situated posteriorly in immediate contact with the buccal mass. It is divided by a deep median notch into two parts, each of which bears fourteen tentacles. On the middle of its inner surface is an oval patch where the integument is raised up into numerous closely set ridges, which are in series with the tentacles, the most external ridges and the most internal tentacles being scarcely distinguishable from one another. This ridged body is referred to by Owen‡ as probably having an olfactory function, and a similar view is expressed by Ray Lankester.§ Van der Hoeven|| dissents from this and expresses the belief that these folds are "only rudimentary digitations completing the circle of the internal labial processes."

It seems somewhat remarkable that a connection of some kind with the function of reproduction should not earlier have been suggested for the entire inner tentaculiferous lobe with its

* Memoir on the Pearly Nautilus, 1832.

† Bronn's Thierreich, Malacozoa, III. Band, p. 1360.

‡ *Op. cit.*

§ Zool. Articles from the Encyclopædia Britannica, Mollusca, p. 137.

|| Trans. Zool. Soc. iv.

tentacles and ridged organ. Its possession is quite as characteristic a feature of the female as the presence of the spadix is of the male. In the male its only representative is a bi-lobed folded body, termed by Van der Hoeven "cushion-shaped incised bodies."

Graham Kerr has apparently suggested such a connection for the ridged organ, as will appear from the following quotation from the abstract already referred to—"The curious laminated organ ventral to the buccal mass in the female, which had been believed to be olfactory, was pointed out as probably having some connection with reproduction—apparently being a glandular apparatus to which the spermatophore of the male becomes attached." That the organ has some such function seems to me extremely probable. In the Dibranchiate Cephalopods the hectocotylised arm is so long that it can readily be used as an intromittent organ for depositing the spermatophores in the mantle-cavity of the female. In the Nautilus, however, such intromission is impossible, and there must be some indirect mode of transmission of the spermatophores. It seems very probable that the whole inner part of the foot of the female is connected with this function, grasping the spadix and receiving the sperms from the cavities on its honey-combed tentacle. The presence in the wall of the mantle-cavity of the female of a pair of glands which appear to correspond to the nidamental glands of the Dibranchiata, would seem to render it probable that the ova must be fertilized in the mantle-cavity. The function of the laminated area, present only in the female, on the inner surface of the outer tentaculiferous lobe may, perhaps, be to form a brood-pouch for the developing ova. Such a function might be suggested for the inner lobe, were it not that the latter is in close contact with the buccal mass, and thus must be subject to frequent changes of position.

One of the six or eight female specimens examined by me presents a condition of the median inner tentaculiferous lobe, which may, perhaps, have a bearing on the functions of the part. In this specimen, which was a good-sized one and fully developed in



other respects, the lobe in question was represented by a rudiment (fig. 4), in which, however, all the parts of the perfected structure were distinctly and symmetrically represented. The condition of this single specimen does not afford sufficient grounds for attempting to make any deductions, but I direct attention to it here, as the examination of further material might establish this as a modification of regular occurrence, and, therefore, requiring to be taken into account in any attempt to explain the uses of the various tentaculiferous lobes.

EXPLANATION OF PLATE.

Fig. 1.—Spadix of mature *Nautilus pompilius* from the outer side (natural size) 1, 2, 3, 4 tentacles, *gld.*, glandular patch.

Fig. 2.—Portion of surface of tentacle 4, magnified.

Fig. 3.—Portion of the surface of glandular patch, magnified.

Fig. 4.—Inner tentaculiferous lobes of specimen referred to in the text.

ON THE OCCURRENCE OF DIATOMACEOUS EARTH AT THE WARRUMBUNGLE MOUNTAINS, N.S.W.

BY PROFESSOR T. W. EDGEWORTH DAVID, B.A., F.G.S.

(Publication deferred for the present.)

NOTES AND EXHIBITS.

Mr. Froggatt exhibited specimens of two species of Scale Insects and parasites bred therefrom; with the following Note:—“About Sydney *Icerya purchasi* is not a common coccid, seldom being found in more than twos or threes upon the small branches, chiefly of *Acacia discolor*, in the bush. This year my colleague Mr. H. G. Smith had a young tree of *Acacia baileyana* in his garden at Tempe covered with this scale, and he brought me a large spray swarming with adult females, which I enclosed in a box. From these I bred some hundreds of small chalcid parasites (*Euryischia lestophoni*, Riley), and also a number of dipterous parasites (*Cryptochaeton iceryæ*, Willist.). At my request, Mr. Smith observed the coccids *in situ*, and he soon found them falling off; and before very long they were all dead. No lady birds (*Coccinellidæ*) or their larvæ were seen upon the tree, which was cleared of the pest by the minute parasites above mentioned; and it seems evident that in this part of Australia we owe much more to these parasites than to their coleopterous enemies for our immunity from the cottony cushion or fluted scale insects as serious pests. The Floridian scale (*Icerya roseæ*, Riley and Howard) has been very plentiful upon the foliage of the Grevilleas and Hakeas on the Illawarra line, and from them I have bred the same species of dipterous parasite, and numbers of the secondary parasite, a chalcid that is parasitic upon the fly larvæ *Ophelosia crawfordi*, Riley, and is therefore not an enemy of the scale insects.”

Mr. Waite sent for exhibition a specimen of *Peripatus leuckartii*, Säng., from Colo Vale, near Mittagong, and recorded localities for other specimens, including some collected by Mr. C. J. McMasters at Moree. As *Peripatus* has been supposed hitherto to be confined to the table-land and coastal districts, its occurrence so far inland as Moree is particularly noteworthy.

Professor David exhibited mounted and bulk specimens of diatomaceous earth, sanidine tuff, trachyte, and trachyte ash

containing leaves of *Cinnamomum Leichhardtii*, Ett., all from the Warrumbungle Mts.

Mr. Steel exhibited (1) a nodule popularly but erroneously supposed to be of meteoric origin, from the MacDonnell Ranges: (2) a large Crustacean (*Ibacus peronii*) caught at Pymont: and (3) a specimen of growing sugar cane forwarded from the Clarence River by Mr. W. J. Freeman, attacked by Termites; the soft interior of the cane was scooped out, and then filled with a brown deposit; the results of a chemical analysis of the latter were submitted for comparison with those of an analysis of a fresh sample of the deposit from an ordinary Termite nest.

Mr. North called attention to the numbers of dead specimens of Mutton Birds (*Nectris brevicaudus*), near Sydney, washed up on the beaches during the past fortnight, and to which reference had been made in recent issues of the "Sydney Morning Herald" by Mr. Cavendish Liardet and Mr. Woolcot-Waley. In company with the former gentleman Mr. North visited the beach at Bondi on the 30th inst., and found hundreds of the bodies of these birds. Several fresh specimens were collected in the hope that an examination would throw some light on the cause of the unusual mortality in this species. Usually it is a rare bird in New South Wales waters, and just now has probably been driven from the south, where it is abundant, by severe gales. Mr. Brazier had recorded at a meeting of this Society in December, 1880, a similar instance of mortality among several species of sea birds (Proceedings, Vol. V., p. 637).

WEDNESDAY, NOVEMBER 27TH, 1895.

The last Ordinary Monthly Meeting of the Society for the current Session was held at the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, November 27th, 1895.

The President, Mr. Henry Deane, M.A., M.I.C.E., in the Chair.

The President announced the deaths of Professor Sven Ludvig Lovén, the veteran Swedish naturalist, an Honorary Member, and Mr. J. Bracebridge Wilson, M.A., of Geelong, an Ordinary Member.

DONATIONS.

Entomological Society of London—Transactions, 1895. Part iii. *From the Society.*

Royal University of Upsala—Meddelanden från Mineralogisk-Geologiska Institution. Nos. 14-15. *From the University.*

Bureau of Agriculture, Perth, W.A.—Journal. Vol. ii. Nos. 22-24 (Oct.-Nov., 1895). *From the Secretary.*

Bombay Natural History Society—Journal. Vol. ix. No. 3 (March, 1895). *From the Society.*

Perak Government Gazette. Vol. viii. Nos. 24-26 (Sept.-Oct., 1895). *From the Government Secretary.*

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Geelong Field Naturalists' Club—The Geelong Naturalist. Vol. v. No. 1 (Oct., 1895). *From the Club.*

Department of Agriculture, Sydney—Notes on the Commercial Timbers of New South Wales. By J. H. Maiden, F.L.S. *From the Department.*

Pamphlet entitled "Census of Plants of the Cape Otway Forest." By G. H. Adcock, F.L.S. *From the Author.*

Zoologischer Anzeiger. xviii. Jahrg. Nos. 485-486 (Sept.-Oct., 1895). *From the Editor.*

Société Royale des Sciences de Liège—Mémoires. 2^{me} Ser. T. xviii. (July, 1895). *From the Society.*

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American Museum of Nat. Hist., New York—Bulletin. Vol. vi. (1894); Vol. vii. Sig. 18-19 (pp. 273-304): Annual Report for the Year 1894. *From the Museum.*

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Société Royale Linnéenne de Bruxelles—Bulletin. 20^{me} Année, No. 9 (Aug.-Sept., 1895). *From the Society.*

Muséum d'Histoire Naturelle, Paris—Bulletin. Année, 1895. No. 6. *From the Museum.*

Australasian Journal of Pharmacy. Vol. x. No. 119. (Nov., 1895). *From the Editor.*

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ON SOME DEVELOPMENTS OF THE MAMMALIAN PRENASAL CARTILAGE.

By R. BROOM, M.D., C.M., B.Sc.

(Plate XLIV.)

The prenasal element has been shown by Kitchen Parker* to be a median cartilaginous development found in the anterior part of the head and arising in connection with the front part of the cranial trabeculæ. Though this element is represented in all the groups from the Elasmobranchs to Mammals, in the majority of forms it is either rudimentary or only found in the young, and in the adult it rarely attains any great degree of development.

In the Elasmobranchs the prenasal cartilage is a well-developed structure, and forms the axis of the large rostrum in the Skate and other fishes. The rudimentary prenasal found in most higher forms is probably an inheritance from these cartilaginous fishes.

In the bony fishes with the development of the premaxillary bones an agent was provided which served the double purpose of cutting the water and of giving a firm support for the teeth, and the need for the prenasal being thus gone we find it reduced to a mere rudiment.

The premaxillary bones in almost all the higher forms with their important tooth-bearing function prevent the development of the prenasal cartilage, which though sometimes an element of importance in the very young animal, in most cases becomes obliterated by the developing premaxillaries.

In birds the prenasal forms the framework of the beak in the early embryo, but as development advances it gradually becomes encroached upon by the premaxillaries on either side. In the

* W. K. Parker. Various Monographs on Development of the Skull, Phil. Trans.

skull of an embryo chick of the middle of the second week as figured by Parker,* the prenasal is seen as a well-developed median cartilage, passing to the front of the beak and separating the two premaxillaries from each other. In the chick two days old the premaxillaries have united and quite obliterated the prenasal in front, reducing it to a small median spur extending in front of the nasal septum and lying on the palatal surface of the hinder part of the united premaxillaries. In the old bird the cartilage has quite disappeared.

In the mammalia where the premaxillaries are generally well developed to support the incisor teeth, the prenasal cartilage is, as might be supposed, usually rudimentary or absent. There is moreover in most mammals another peculiarity unfavourable to the existence of the prenasal—the union of the prevomer with the premaxillary. As I have recently shown,† the mammalian prevomer, though occasionally a distinct element (*Ornithorhynchus*, *Miniopterus*), usually early anchyloses with the premaxillary or becomes ossified in connection with it. As this structure lies below the nasal septum, in being connected anteriorly with the premaxillary, the anterior palatal region becomes to a large extent shut off from the nasal septum, and in the adult condition where the bones are closely articulated in the middle line completely so. In a few interesting instances, however, the prenasal element has succeeded in asserting itself.

The most remarkable developments of the prenasal are in the egg-laying mammals—*Ornithorhynchus* and *Echidna*. The premaxillaries in both these forms are edentulous and feebly developed, and in neither are they provided with palatine processes, as in *Ornithorhynchus* the prevomer is distinct and in *Echidna* quite absent.

* W. K. Parker. On the Structure and Development of the Skull of the Common Fowl. Phil. Trans. 1869, p. 755.

† R. Broom. "On the Homology of the Palatine Process of the Mammalian Premaxillary." Proc. Linn. Soc. N.S.W. (2nd Ser.) Vol. x. 1895.

In a recent paper* Wilson and Martin have carefully described some of the chief points in the anatomy of the muzzle of *Ornithorhynchus*. They have dealt principally with the structure and relations of the large rostral cartilage. By a series of transverse vertical sections the authors show that the nasal septum on passing forward divides into a slender upper and a well developed lower part, and that this latter being continued forward, broadens out and becomes the rostral cartilage. For a short distance the rostral cartilage is shown to be clasped between the premaxillaries, recalling the condition of the embryonic bird. From this relationship and from the fact of its being a continuation of the nasal septum, the rostral cartilage is held to be an enormously developed prenasal. With their view I must express my entire agreement. While my researches confirm the accuracy of the sections figured by Wilson and Martin, they reveal an interesting point apparently not observed by these authors. The rostral cartilage does not extend forward to the front of the beak as an entire sheet. Almost immediately in front of the plane passing through the anterior parts of the premaxillaries the cartilage becomes abruptly arrested in the middle line; but while this is so, the lateral parts extend forward almost to the front of the beak, where they again approach each other, meeting, or almost so, in the middle line. There is thus left in the middle an oval space entirely free from cartilage. This arrangement I have found in three different individuals (two males and one female). The lateral portions of the cartilage curve round backwards along the outer sides of the rostral crura, supporting the lip as shown by Wilson and Martin. It seems probable that this whole complicated marginal cartilage is a development of the prenasal, for though in the Skate the prenasal rostrum supports a pair of labials at its anterior part, in the higher forms when labial cartilages are present they never seem to have the same relations to the premaxillaries as is found in the *Platypus*.

* J. T. Wilson and C. J. Martin. "Observations upon the Anatomy of the Muzzle of *Ornithorhynchus*." Macleay Memorial Volume, Linn. Soc. N.S.W. 1893.

In fig. 1, Pl. xlv., is represented a longitudinal median section of the snout of *Ornithorhynchus* which shows the relations of the cartilages. The nasal septum proper (*n.s.*) is seen in front to divide into the upper delicate cartilaginous process (*a.n.s.*) and the lower well developed prenasal (*p.n.*). The upper process passes between the anterior nares, whose position is indicated by the dotted lines (*a.n.*), and is probably the homologue of the anterior part of the nasal septum in the higher mammals, as to it are attached, in its hinder part at least, the alinasals. Though in the region of the anterior nares it is considerably removed from the prenasal plate, on passing forward it approaches the latter, and ends in close connection with it, at the point where the prenasal becomes arrested in the middle line. This point (marked *) probably represents the anterior end of the beak in the ancestor of the Platypus, as not only do the two cartilages here end together, but this is practically where the two premaxillaries would meet if they came together. Connected with it, moreover, there is a further feature of importance. On the upper side of the beak in the middle line is a small area of thickened epithelium (*c*) unlike that of the rest of the beak. This is probably the remains of the caruncle. If it be so, and it is quite perceptible externally in the fresh specimen even to the naked eye, it corrects the statement of Owen's* that no trace of the caruncle can be found in the adult. Whatever be its signification, it is evidently closely related to the supposed apical point of the primitive beak, as a series of fibrous bands pass from it to the latter.

In the anterior part of the section is seen the anterior union of the incurving lateral portions (*pn'*), and between this and the supposed apical point the cartilage is seen to be absent.

The same section illustrates a few other points of interest. The prevomer or dumbbell-shaped bone (*P.vo.*) is seen cut longitudinally. Immediately in front of it Jacobson's cartilage (*J.c.*) may be noticed at the place where towards the anterior part of the organ the cartilages meet in the middle line. Behind the

* R. Owen. "Monotremata." Todd's Cyclop. Anat. and Phys.

prevomer a small piece of cartilage is seen cut across (*S.c.*). This is Stenson's cartilage at the place where near the posterior part of Jacobson's organ it passes below the organ and meets its fellow of the other side. Behind this are seen the maxillary and the vomer, and between this latter and the prevomer the large inter-narial opening recently described by Prof. Wilson.*

In the near ally of the Platypus—the Echidna—the condition of the prenasal illustrates the Monotreme type in a much less specialised form. Here we have a closer approach to the condition in the bird. In fig. 2, Pl. XLIV., is represented a median longitudinal section of the anterior part of the snout. The nasal septum (*n.s.*) closely resembles that in *Ornithorhynchus*, and like it divides into a small upper part (*a.n.s.*) and a larger lower—the prenasal (*p.n.*). The upper, as in the Platypus, supports the alinasals, but instead of passing straight forward, at its anterior part it becomes folded back and rests on the symphysis of the premaxillaries. In the very young specimens as figured by Newton Parker† the prenasal is well developed and bears much resemblance to that in *Ornithorhynchus*. As the animal reaches maturity the prenasal, however, becomes reduced by the developing premaxillaries into a thin plate of hyaline cartilage lying between the adjacent parts of the two bones. In old specimens the hyaline cartilage becomes partly ossified and partly converted into fibro-cartilage, only a little of the original tissue remaining. There is no apparent anterior extension of the prenasal comparable to that in *Ornithorhynchus*.

As has been already remarked in the higher forms, the prenasal is usually aborted by the great development of the premaxillaries. In the Australian Bat (*Miniopterus schreibersii*, Natt.), however, as the premaxillaries do not meet in the middle line, we have

* J. T. Wilson. "Observations upon the anatomy and relations of the Dumbbell-shaped Bone in *Ornithorhynchus*, &c." Proc. Linn. Soc. N.S.W. (2nd Ser.) Vol. ix. 1894.

† W. N. Parker. "On some points in the Structure of the Young of *Echidna aculeata*." Proc. Zool. Soc. 1894.

here an opportunity of seeing the uncomplicated higher mammalian condition, and though the bat is high in the scale of organisation it will thus be well to consider it first. If a transverse vertical section be made in the plane which passes through the opening of Jacobson's organ into Stenson's duct there is seen (fig. 4) a delicate nasal septum (*n.s.*) which does not reach the level of the nasal floor, with on either side of its base the usual cartilages of the nasal floor (*n.f.c.*), here distinct from the alinasals. Inferiorly Stenson's ducts (*n.p.c.*) are seen passing up from the palate with between them the papilla. Round the upper part of the duct is a sickle-shaped piece of cartilage whose inner part, surrounding what is practically the anterior part of Jacobson's organ, is the anterior continuation of Jacobson's cartilage, and the outer part of which is the similar continuation of Stenson's cartilage. Between the portions representing Jacobson's cartilage is found a small median mass (*p.n.*) which from its relations may almost certainly be regarded as the prenasal. Posteriorly this cartilage has no connection with the nasal septum, but it occupies a position somewhat similar to that of the prenasal in the foetal calf (fig. 7). A very little in front of this plane the small prenasal is seen sending downwards two lateral plates which pass one to each side of the papilla and thus forming its framework (*p.n.* fig. 5). There is no further anterior extension. Though the downward lateral processes can hardly be homologous with the lateral extensions of the prenasal in *Ornithorhynchus*, they illustrate potentialities of the structure usually latent. The condition is, however, specially interesting as throwing light on the peculiar structures found in the Marsupials.

In both Diprotodont and Polyprotodont Marsupials there is in the anterior part of the palate an unusually well marked papilla which generally separates the naso-palatine ducts considerably. It is remarkably developed in the Wombat and very well in the Phalangers. In all the forms I have examined (*Macropus*, *Trichosurus*, *Dasgurnus* and *Perameles*) this papilla is supported by a cartilaginous plate. In the adult *Trichosurus* there is a median ridge from which lateral plates pass off. Here and there the

lateral portions are detached or perforated, as if the whole plate were fundamentally a median structure with lateral expansions. In fig. 6 is represented a transverse vertical section of the snout of the Bandicoot (*Perameles nasuta*) in the plane of the anterior part of Jacobson's Organ. Here there is no distinct ridge in the middle line, and the plate is moderately uniform in thickness. This papillary cartilage has no direct connection with any other cartilage. In fig. 3 is shown a median longitudinal section of the nasal region of a pouch specimen of the common Phalanger (*Trichosurus vulpecula*, Kerr), illustrating the relations of the small papillary cartilage (*p.c.*). The premaxillary (*Pmx*) is seen united with the prevomer which forms its palatine process (*p.Pmx*): a dotted line indicates the limits of the different elements as observed in sections slightly out of the mesial plane. The posterior end is found situated near the posterior border of the symphysis of the premaxillary proper, as if it were shut off from its proper relations by the union of the premaxillary with the prevomer. When fig. 6 is compared with fig. 5 representing the condition in the Bat the resemblance between the cartilages of the papillæ is most striking; the only important difference is that in the Marsupial the upper portion representing the prenasal proper is lost. While thus we have in the Bat a prenasal cartilage which gives rise to a support for the papilla, in the Marsupial we have the remains of a similar development, only the papillary portion being left.

In Klein's* paper on the Organ of Jacobson in the Guinea Pig in referring to the relations of Stenson's ducts near their palatal opening he calls attention to "a smaller or larger apparently isolated nodule of cartilage found between the two ducts." This he regards as a detached portion of Stenson's cartilage, but in view of this condition in Marsupials and the Bat I think not improbable that it may be the rudiment of a prenasal development.

Fig. 7 represents a section of the nose of a 6-inch foetal calf. Here the prenasal is well developed and passes between the premaxillaries. This condition shows the connection between the

* Q.J.M.S. Vol. xxi. (1881), p. 229.

Monotreme type on the one hand and that of the Bat on the other, while by contrasting figures 7, 4, 5 and 6 the nature of the Bat and Marsupial developments becomes manifest.

My best thanks are due to Mr. A. G. Hamilton for the specimen of bandicoot examined, and to Prof. Wilson and Mr. J. J. Fletcher for other kind assistance.

EXPLANATION OF FIGURES.

Plate XLIV.

Reference Letters.

a.n., anterior nares—relative position indicated by dotted lines; *a.n.s.*, anterior portion of nasal septum; *c.*, supposed remnant of caruncle; *Fr.*, frontal; *i.n.p.*, internasal passage; *J.c.*, Jacobson's cartilage; *J.o.*, Jacobson's organ; *Mx.*, maxillary; *Na.*, nasal; *n.f.c.*, nasal-floor cartilage; *n.p.c.*, naso-palatine canal; *n.s.*, nasal septum; *p.c.*, papillary cartilage; *Pmx.*, premaxillary; *p.n.*, prenasal cartilage; *p.n'*, prenasal at its anterior part; *p.Pmx.*, palatine process of the premaxillary; *P.Vo.*, prevomer; *S.c.*, Stenson's cartilage; *Vo.*, vomer; *v.s.*, vascular spaces; *, supposed apical point of primitive beak in *Platypus*; †, a small detached piece of cartilage of doubtful signification.

Fig. 1.—Longitudinal median section of the snout of *Ornithorhynchus* ($\times 5$).

Fig. 2.—Longitudinal median section of the snout of *Echidna* ($\times 5$).

Fig. 3.—Longitudinal median section of head of 4-in. mammary fœtus of common Phalanger (*Trichosurus vulpecula*) ($\times 4$).

Fig. 4.—Transverse vertical section of portion of nose of Australian Bat (*Miniopterus schreibersii*, Natt.) in the region of the outlet of Jacobson's organ ($\times 45$).

Fig. 5.—Transverse vertical section of portion of nose of Australian Bat (*Miniopterus schreibersii*, Natt.) near the front of Stenson's duct ($\times 45$).

Fig. 6.—Transverse vertical section of portion of nose of the Bandicoot (*Perameles nasuta*) in region of the anterior part of Jacobson's organ ($\times 12$).

Fig. 7.—Transverse vertical section of portion of nose of 6-in. fœtal calf ($\times 6$).

ON A SMALL FOSSIL MARSUPIAL WITH LARGE GROOVED PREMOLARS.

BY R. BROOM, M.D., C.M., B.Sc.

(Plates xxv. and xlv.)

At the Meeting of the Linnean Society on 26th June I communicated a paper "On a new fossil Marsupial allied to *Hypsi-prymnus*, but resembling in some points the *Plagiaulacidae*," in which I described two fragments of the upper and a portion of the lower jaw of a small Marsupial, under the name *Burramys parvus*, and regarded the form as being related to the Rat Kangaroo, but exhibiting apparently by a parallel development some characters of the *Plagiaulacidae*. Of this paper an abstract was published at the time. Since then I have been fortunate in discovering some more perfect specimens which throw much additional light on the structure of the form. I have therefore thought it advisable, with the permission of the Council, to withdraw the previous paper and give a more complete description in the light of the more recent finds.

The specimens I have obtained are all from a small calcareous deposit in the neighbourhood of Taralga, N.S.W. This deposit is situated on the very top of a limestone hill, and is evidently the remains of the floor of a cave, whose roof and sides have long since been weathered away. The stone is very hard and consists of a brownish lime deposit in which are imbedded innumerable small bones, with the remains of a few stalactites and an occasional calcite rhomb. The bones are mostly those of small marsupials, though I have also found the remains of at least one species of rodent and the very perfect cranium of a small bird.

Most of the marsupials belong either to extinct species or to species not now living in the district.

The subject of the present paper is one of the most interesting forms found, and as I am not aware of its having been previously observed, and as its dentition is unlike that of any known marsupial, I have formed a new genus for it, called after the aboriginal name of the district.

BURRAMYS PARVUS, gen. et sp. nov.

The form is characterised by having above and below a large grooved premolar followed by three well developed molars. In the lower jaw the large premolar has six well marked grooves on each side passing upwards and slightly backward and giving the tooth a serrated edge. As the grooves run approximately parallel to the anterior border of the tooth and to each other, and as the anterior and posterior borders converge considerably above, there is left a considerable portion of the posterior part of the tooth ungrooved. This premolar is placed obliquely in the jaw, the line of its edge passing considerably outwards from the line of the molars. The first molar bears some resemblance to the corresponding tooth in *Petaurus*, having two posterior and a large anterior cusp: it differs, however, in the anterior cusp pointing more outwards. The second molar is slightly oblong and has four well developed cusps; of these the anterior outer cusp has a small secondary one springing from it, while the posterior inner one is partly divided by a well marked furrow. The third molar is less developed and apparently quadritubercular. Behind this there appears to be a rudimentary single rooted and apparently functionless fourth molar, which is generally lost in the specimens found. In front there is a long straight flattened and pointed incisor directed considerably upwards from the axis of the jaw. Between the base of this incisor and the anterior part of the large premolar are five minute tooth sockets which have apparently been occupied by two double-rooted premolars and a single-rooted anterior tooth—possibly a minute second incisor. Behind, the jaw has a very marked inflected angle

which passes somewhat downwards. The large depression on the outer side is bounded in front by a well marked ridge, but does not communicate with the dental canal. The main portion of the jaw supporting the molars and the large premolar is very stout proportionately. In the upper jaw only the cheek teeth are at present known. There is a large premolar grooved and serrated as in the lower jaw, having six well marked grooves which run downwards and backwards. The grooves run parallel to the anterior border and leave the posterior and upper third of the tooth ungrooved. Behind the large premolar are three true molars: whether there may be a rudimentary fourth as in the lower jaw is at present unknown. The first is the largest. It has two moderately large blunt tubercles on the outer side, and two smaller ones on the inner, while a small fifth is situated at the anterior and inner corner. The upper third molar is small.

The following are some of the principal measurements :—

From 1st to 3rd upper molars	3·2 mm.
Length of 1st upper molar.....	1·3 mm.
Height of upper premolar	1·7 mm.
Length (antero-posterior) of upper premolar ...	2·0 mm.
From 1st to 3rd lower molars	3·5 mm.
Length of lower incisor	6·3 mm.
From point of lower incisor to front of premolar	8·2 mm.
Depth of lower jaw at 1st molar	3·5 mm.

Locality.—Near Taralga, N.S.W.

Geological Formation.—Pleistocene (?).

Of this form I have discovered five or six moderately good lower jaws, the anterior portion of another, and three fragments of the upper. The hard matrix and the friable nature of the bones render it very difficult to develop the more delicate specimens, and in the case of *Burramys* the difficulty is enhanced by the obliquity of the large premolar, so that it becomes almost

impossible to split the stone without breaking either the bone or the teeth.

Taking into consideration the various points of structure so far as known, it will be noticed that not only does the form present features which distinguish it from any known genus, but that in it we have a combination of characters which render it difficult to be certain whether it belongs to the *Macropodidae* or to the *Phalangeridae*. As regards the structure of the jaw, the affinities on the whole are with the latter, and as regards the teeth apparently with the former. The absence of any opening between the dental canal and the hollow on the outer side of the hinder part of the jaw would seem to remove the form from the *Macropodidae* and point to its connection with the Phalangers. But this point cannot be of any great value, as though the opening is generally absent in the *Phalangeridae* it is present in the genus *Petaurus*. The large grooved premolars, though much better developed proportionally, appear to be constructed on the same type as those of *Æpyprymnus* (*Hypsiprymnus*) and a type quite distinct from that of the Phalangers. In *Trichosurus* where there are rudimentary indications of grooves it is on the hinder part of the tooth, the anterior part being developed into a powerful smooth cusp. The molars present a somewhat archaic type. There is no indication of ridging as in most of the existing types, nor is there the simple regularity of cusps found in *Petaurus*. In the little accessory tubercles we seem to have a feature suggestive of the multi-tubercular molars of the Secondary Marsupials. The minute premolars certainly recall the similar rudimentary teeth in *Pseudochirus*, *Petaurus*, &c., but similar rudimentary teeth must also have been present in the primitive *Macropodidae*.

On the whole it would seem that we have in *Burramys* one more link in the chain binding the Kangaroos and the Phalangers. The main links would thus be—*Macropus*, *Æpyprymnus*, *Hypsiprymnodon*, *Burramys*.

The types have been placed in the Australian Museum, Sydney.

REFERENCES TO FIGURES.

Plate XLV.

Burramys parvus.

- Fig. 1.—Outer view of lower jaw ($\times 10$).
 Fig. 2.—Upper view of anterior part of right lower jaw ($\times 10$).
 Fig. 3.—Upper view of lower right cheek teeth ($\times 13$).

Plate XXV.

- Fig. 1.—Inner view of left mandible ($\times 5$).
 Outline of jaw from another specimen.
 Fig. 2.—Portion of left upper jaw showing the large premolar and the origin of the zygomatic arch ($\times 13$). (The front part of the maxillary and the zygomatic arch are considerably fore-shortened.)
 Fig. 3.—Right upper cheek teeth ($\times 13$). (The premolar is broken off near the base, and only the roots of the third molar are shown; judging from the lower teeth the roots of m^3 have evidently been slightly displaced outwards.)

ON A SMALL FOSSIL MARSUPIAL ALLIED TO
PETAURUS.

By R. BROOM, M.D., B.Sc.

(Plate XLVI.)

In the bone breccia deposit in the neighbourhood of the Wombeyan Caves in which I discovered *Burramys*, I have been fortunate in finding the remains of another small marsupial, also new to science. Of this form I have obtained the greater part of an upper jaw, and an almost complete and two imperfect lower jaws, and also a most important portion of the cranium.

From the structure of the teeth the form is closely allied to *Petaurus* and to *Gymnobelideus*, and though further details may lead to its being included in one or other of these genera, as it presents features distinct from both and also affinities with each I have provisionally placed it in a new genus.

PALÆOPETAURUS ELEGANS, g. et sp.nov.

Dental Formula :—As in *Petaurus* and *Gymnobelideus* so far as known.

Upper Jaw :—Incisors unknown; canine somewhat conical, less flattened than in *Petaurus* and somewhat shorter proportionately; first premolar smaller than the canine, conical and rather blunt at the apex, single-rooted, antero-posterior length of base very slightly greater than the height, in the unworn tooth possibly less; second premolar (pm.³) with very low crown as in *Petaurus* and considerably developed antero-posteriorly, with the main cusp a little in front of the centre of the tooth instead of behind it as in *Petaurus*, and with two well developed diverging roots; third premolar (pm.⁴) large and triangular, proportionately larger than in *Petaurus* and *Gymnobelideus*,* and appreciably higher than the canine; first molar differing from *Petaurus* in having the two

* McCoy. Prodr. Zool. Vict. Decade x. Pl. xci. (1883).

inner cusps very small and brought close together, giving the tooth more of a rounded triangular shape than the rough quadrangular in *Petaurus*—judging from the figure a similar condition would seem to be present in *Gymnobelideus*; second molar apparently similar to the first and thus differing from *Gymnobelideus*, where it appears to be oblong and quadrangular; the fourth molar appears to resemble that of the two allied genera.

Lower Jaw.:—Incisor well developed, almost horizontal, sharp pointed and curving slightly upwards; minute premolars unknown, but judging from the sockets probably as in *Petaurus*; fourth premolar about half the size of the first molar with a blunt pointed cusp on the middle of the anterior half, and a rounded cusp on the posterior end; the first molar similar in structure to that in *Petaurus*, but with a less development of the anterior cusp; the second molar differs from that in *Petaurus* in having a greater development of the anterior and inner cusp, which from the inner side gives it much the appearance of the first molar; third and fourth molars unknown.

The lower jaw is much slenderer than in *Petaurus*, and bears a considerable resemblance to that in *Gymnobelideus*. The external muscular depression is even shallower than in *Petaurus breviceps*. In *Gymnobelideus* according to the figure the depression ends in front rather sharply towards the lower part of the jaw, as in *Petaurus*. In *Palæopetaurus* the depression ends, but not abruptly, somewhat above the line of the axis of the jaw, and thus differs from both the allied genera. The angle of the jaw appears to be slender, and more like that of *Gymnobelideus* than of *Petaurus*.

Of the upper jaw little is known beyond the teeth, but sufficient of the palate is preserved to show that though there may have been a palatal vacuity, it must have been much smaller than in *Gymnobelideus*.

I have discovered two perfect frontal bones, which, with little doubt, are to be referred to this form. These present a remarkable resemblance to those of *Gymnobelideus*, and differ from those of *Petaurus* in the absence of the post-orbital ridges.

The following are some of the principal measurements :—

Upper jaw.		Lower jaw.	
Canine, height about	1.1 mm.	Length of lower jaw from	
ant. post. length about...	1.1 "	front of incisor to	
1st premolar, height..	.8 "	condyle.....	23.2 mm.
ant. post. length	.9 "	Depth behind m ³	3.3 "
3rd premolar, height	.4 "	Depth behind m ¹	3.8 "
ant. post. length	1. "	Lower molars.....	6.3 "
4th premolar, height	1.2 "	Incisor.....	5. "
ant. post. length	1.6 "	Incisor to m ⁴	13. "
1st molar, ant. post. length	1.8 "		
2nd molar, ditto.....	1.7 "		

Locality.—Near Taralga, N.S.W.

Formation.—Pleistocene (?).

In taking into consideration the various points considered above, it will be observed that the remains are those of a small animal in many respects resembling *Gymnobelideus*, but with a number of the characters of *Petaurus*. In many respects it stands intermediate between the two genera, and not improbably may be the common ancestor of both. In *Gymnobelideus* upper pm¹ and pm³ are described as "both triangular and single rooted." In *Petaurus* all the upper premolars are "two-rooted." In *Palaeopetaurus* we have the intermediate condition in pm¹ single-rooted, and pm³ double-rooted. Then, again, as to the relative sizes of these teeth, in *Petaurus* we have "p¹ nearly as large as p⁴, p³ much smaller, but not minute." In *Palaeopetaurus* pm⁴ is at least a half larger than pm¹, while pm³ is but half the height of pm¹. In *Gymnobelideus* the two front premolars are much more equal.

In conclusion I must express my gratitude to Mr. J. J. Fletcher for his kindness in furnishing me with references, &c.

EXPLANATION OF PLATE.

Palaeopetaurus elegans.

Fig. 1.—The right maxillary teeth with palate—viewed slightly obliquely from below (× 8.3).

Fig. 2.—Outer view of right lower jaw (× 4).

Fig. 3.—First and second lower molars—viewed from within (× 16).

ON THE ORGAN OF JACOBSON IN AN AUSTRALIAN BAT (*MINIOPTERUS*).

BY R. BROOM, M.D., B.Sc.

(Plate XLVII.)

In the course of a recent investigation of certain details in the comparative anatomy of Jacobson's Organ, the results of which I have embodied in a thesis recently presented to Glasgow University, I discovered in the common little Australian bat, besides a number of other interesting points, a well-developed organ of Jacobson.

Jacobson's Organ, as is well known, is found in the large majority of Mammals—from the Monotremata, where it is greatly developed, to man, where it is rudimentary. In the majority of orders it is typically present, but in the higher forms it is frequently absent. Herzfeld,* who has examined a very considerable variety of animals, found it quite absent in two Old World Monkeys, *Cercopithecus* and *Inuus*, though present in the New World genus, *Hapale*, and also in the Lemur. Among the *Chiroptera* he found the organ to be absent in the flying-fox (*Pteropus edwardsi*), and also absent in a native (German) bat, of which unfortunately the species was not determined. From these observations it has naturally been concluded that the organ is absent in the order *Chiroptera*.

Since giving notice of the present communication, and on the eve of sending it off, Dr. Elliott Smith, has kindly called my attention to a paper just recently published on the Organ of Jacobson in the *Chiroptera* by Mm. Duval and Garnault†. In

* P. Herzfeld, "Ueber das Jacobson'sche Organ des Menschen and der Säugethiere." Zool. Jahrb. 1889.

† M. Duval and P. Garnault, "L'organe de Jacobson des Chiroptères"; Compt. Rend. Hebd. des Séances de la Société de Biologie, x. Ser. 28 June, 1895.

this paper the authors call attention to the fact that the organ is not invariably absent in the order, and comment on the curious fact that though the organ is quite absent in *Vespertilio murinus* and *Rhinolophus ferrum-equinum*, in another insectivorous bat, *Vesperugo pipistrellus* there is a moderately developed organ. They do not, however, appear to have made any study of the peculiarities of the organ.

In the common Australian bat which I have studied (*Miniopterus schreibersii*, Natt.) the organ is not only present, but is unusually well-developed; and furthermore it presents certain features which distinguish it from the ordinary mammalian type.

In my recent thesis have been recognised in the Placental Mammals and Marsupials at least three types of Jacobson's Organ, and of the third type two well marked varieties. In the Marsupialia we have a simple generalised type which is moderately closely related to Monotreme type as found in *Echidna*. The organ in Rodents, on the other hand, is peculiarly specialised in opening into the nasal cavity and not into Stenson's duct, though in other respects it comes near to the Marsupial type. In all the other orders of Mammals in which the organ has been examined, so far as I am aware, a third type is followed. Here the organ opens into Stenson's canal as in Marsupials, but the canal is greatly developed in length and passes forwards, becoming merged with Jacobson's duct. There is further a precurrent process of Jacobson's cartilage on the inside of Jacobson's duct, and a similar process on the outer side of Stenson's duct. These, on passing forward, unite above and form a common cartilage for the common duct. This is the type of the Dog, Cat, Sheep, &c. In the bat we have a variety of this type. The cartilages and ducts are arranged in a somewhat similar way, but there is an absence of the great elongation of the ducts, which in their mode of connection with the nasal cavity, and with Jacobson's Organ, present a much nearer approach to the simple Marsupial type.

In *Miniopterus*, though the premaxillaries are fairly well developed, they do not meet in the middle line, a condition

differing considerably from the normal mammalian type. In the middle line is a well developed papilla, supported as I have elsewhere* shown by a development of the prenasal cartilage. A section through the middle of the papilla shows on either side a wide Stenson's duct, which at its upper part is roofed over and protected at the sides by the anterior developments of Stenson's and Jacobson's cartilages. Above this is found the curved cartilage of the nasal floor.

A short distance behind this plane, in a manner similar to that figured by Herzfeld† in the Lemur, the cartilage of the nasal floor becomes divided into an inner and an outer part, as does also the arched cartilaginous roof of Stenson's duct. The two inner parts unite to form Jacobson's cartilage proper; and the outer to form the hinder part of Stenson's cartilage. This is the condition shown in fig. 1. At the inner side of the upper part of Stenson's duct it is found receiving the duct of Jacobson.

Almost immediately behind this Stenson's duct is found opening into the nasal cavity (fig. 2). Here Jacobson's duct is small, and lined with squamous epithelium. On this plane there is no ossification in the neighbourhood of the septum, but a very short distance beyond brings us to a plane cutting the anterior part of the prevomer (fig. 3, *P.vo.*). In a recent paper read before this Society‡ I called attention to this remarkable bone in discussing the homologies of the palatine process of the premaxillary. It is well illustrated in figs. 4 and 5—the former representing an anterior section; the latter a section near its posterior part.

On approaching the region of the prevomer, Jacobson's Organ gradually becomes greatly developed, attaining its maximum near the posterior part of the prevomer. In this region the cartilage of Jacobson forms an almost complete tube, only open slightly on

* Proc. Linn. Soc. N.S.W. 2nd Ser. Vol. x. pt. 4, 1895.

† *L.c.*

‡ Proc. Linn. Soc. N.S.W. 2nd Ser. Vol. x. pt. 3, 1895.

the outer side. Both the upper and lower ends curve inwards slightly and suggesting the formation of a rudimentary turbinal. The organ itself on section is found to have the usual mammalian shape, though here the regular kidney-shape is slightly distorted, assuming more the Marsupial pattern. The inner wall is composed of the usual neurepithelium, the epithelial cells apparently having short cilia. The outer wall has epithelium with long cilia. A single small blood vessel runs parallel to the organ along the hollow of the outer wall—a feeble representative of the large vascular plexuses of *Echidna* and *Ornithorhynchus*, or even of the rabbit. Of mucous glands there are apparently none within the cartilaginous capsule, and no very abundant supply outside. A number of the septal glands towards the posterior part of the organ appear to supply it with fluid. The organ ends very abruptly.

Stenson's cartilage is well developed, and passes inwards beneath the capsule of Jacobson, somewhat resembling the condition in *Echidna*.

In conclusion the type of organ appears to be intermediate between that of the Marsupial and that of the Carnivore, though more nearly allied to the latter. As regards the relative size of the capsule of Jacobson, it is larger than in any other mammal I know of, even larger than in *Ornithorhynchus* proportionally; in the larger animal, however, owing to the relatively smaller size of the cells, there must be a very much larger number of nerve elements.

I must acknowledge my indebtedness to Messrs. Etheridge and Waite, of the Australian Museum, for identifying for me the bat; and also to Dr. Elliott Smith who not only called my attention to the paper by Duval and Garnault, but most kindly made for me a manuscript copy of the paper, which I could not otherwise have had an opportunity of seeing.

EXPLANATION OF PLATE.

REFERENCE LETTERS:—*J.C.*, Jacobson's cartilage; *J.D.*, Jacobson's duct; *J.O.*, Jacobson's organ; *n.s.*, nasal septum; *p.n.*, prenasal; *P.vo.*, prevomer; *S.D.*, Stenson's duct; *S.C.*, Stenson's cartilage; *vv.*, veins.

Figs. 1-3.—Transverse vertical sections through anterior part of Jacobson's organ ($\times 25$).

Figs. 4-5.—Transverse vertical sections through anterior and posterior parts of Jacobson's organ ($\times 60$).

Fig. 6.—Section across posterior part of Jacobson's organ, showing its relations and relative development ($\times 12$).

NOTE ON THE PERIOD OF GESTATION IN *ECHIDNA*.

BY R. BROOM, M.D., B.Sc.

On 5th September I had brought me an adult male and female *Echidna*, which had been found together. There was no egg or young one about the female, and little indication of even the pouch. Considering it probable that impregnation had taken place, I resolved to keep the specimens alive and await developments. The two were placed together in a large box that their behaviour might be noted; but they appeared to have no interest in each other. The male was rather inactive, and unless disturbed, for the most part remained quietly in the bottom of the box. The female, on the other hand, was most persistent in its bids for liberty, and twice succeeded in escaping; on one occasion splitting a $\frac{3}{8}$ -in board and wrenching out three nails. Fortunately, on both occasions, it was recaptured. The male, which absolutely refused to take either food or drink, died on the 18th of the month. The female continued to be apparently in the best of health. Occasionally it would take a little milk or water, but curiously enough refused ants; and when placed on an ant bed its only desire seemed to be burrow. In fact it was this unusually great desire to burrow that led to its capture on the two occasions it escaped.

On the 2nd October, on taking the *Echidna* out of the box, I found that it had developed a well marked pouch, and that in it had been placed at its most posterior part an egg. Though well protected by the lateral folds of the pouch, the egg seemed chiefly secured by the long hairs plastered across it. Among the straw was found a second egg, apparently discarded. As there was no signs of any egg on 30th September, it is probable that one egg was laid on the 1st October and the other on the 2nd. After protecting the pouch egg safely for three days, the mother seems to have removed it, as the torn egg membrane or "shell" was found on the bottom of the box, the contents having been presumably sucked.

Though the female thus disappointed me in my hope of finding accurately the period of incubation, it enabled me to arrive at an approximate idea of the period of gestation. The evidence on this point would have been more conclusive had the sexes been kept apart, but as the male died on the 18th, and was in a very low condition for some days previously, impregnation could not well have taken place later than the 12th, and as during the period of captivity neither appeared to have any interest in the other except to use the body of its companion as a stepping stone while endeavouring to climb out of the box, it seems highly probable that impregnation had taken place when the specimens were captured. If this be so, the period of gestation would be about 26 or 27 days, and even if this were not so, as impregnation could not well have taken place later than the 12th, the period of gestation could not be less than 18 or 19 days.

The eggs of my specimen appeared considerably paler than that figured by Semon,* being of a light cream colour. The unbroken egg measured 14 mm. in its long axis, and about 12·5 mm. across.

I must express my thanks to Prof. Wilson for having had an opportunity of seeing Semon's work.

ADDENDUM (7th Feb., 1896).—I have recently had an opportunity of seeing the person who first observed the two *Echidnas* referred to above—Mr. Angus McInnis. He states that the two were lying together on a slight hollow at the root of a tree, and so far as he could observe front to front, but as on his near approach the two separated and endeavoured to escape, he could not be certain of their exact positions before being disturbed. He, however, assures me that on picking up the male its copulatory organ was protruding about a couple of inches; so that there can be little or no doubt but coitus had just taken place. This, he further states, was on the day previous to my getting them, or 4th September. This additional information removes the previous uncertainty, and enables us to fix the period of gestation at about 28 days.

* R. Semon. "Zool. Forschungsreisen in Australien u.d. Malay. Archipel. Band ii.; Monotremen und Marsupialier." Jena 1894.

PRELIMINARY NOTE ON THE OCCURRENCE OF A
PLACENTAL CONNECTION IN *PERAMELES OBE-*
SULA AND ON THE FŒTAL MEMBRANES OF
CERTAIN MACROPODS.

BY JAS. P. HILL, DEMONSTRATOR OF BIOLOGY, IN THE UNIVERSITY
OF SYDNEY.

(Plate XLIX.)

Some little time ago there came into my hands, through the kindness of Mr. A. M. Lea, a female short-nosed Bandicoot, *Perameles obesula*, which proved, on examination, to be pregnant. Two embryos were found in the left uterus, and one, the largest of the three, in the right. This latter embryo measured 8.75 mm. from end to end of the curved body.

On opening the uteri it was found to be impossible to remove the embryos without tearing the fœtal membranes, and so two of them were preserved enclosed in their membranes and attached to portions of the uterine walls.

Recently I have had the opportunity of examining these embryos in some detail, both macroscopically and microscopically in serial sections, with the result that a true allantoic placenta was discovered.

The fœtal membranes need not be specially considered in this note, since they have essentially the same general arrangement as those of *Phascolarctus* and *Aepyprymnus*, recently described by Prof. R. Semon.* As in these forms the embryo is sunk into the yolk sac, and is partially surrounded by the invaginated upper portion of the yolk sac wall consisting of splanchnopleure (splanchnic mesoderm and entoderm), and distinguished by Semon as the "inneres Blatt." This inner leaf does not, however, so completely surround the embryo in *Perameles* as in *Macropus*,

* Zoologische Forschungsreisen in Australien. Zweiter Band, Erste Lieferung. Monotremen und Marsupialier, von R. Semon.

Aepyprymnus or *Phascolarctus*, and thus the portion of the serous membrane consisting of ectoderm and somatic mesoderm and limiting the extra-embryonic cœlom externally forms a discoidal area of considerable size. With this discoidal area of the serous membrane the allantois fuses, and over it the placental connection is established.

The allantois is well developed and large, and provided with an abundant blood supply. It consists of a long and somewhat flattened stalk, and a terminal expanded and much flattened vesicular portion. The allantoic stalk leaves the embryo immediately behind the yolk stalk, bends round the right side of the embryo, and extending through the extra-embryonic cœlom expands at its distal end to form the flattened vesicular portion which spreads over the discoidal area of the serous membrane above mentioned. In the stalk the allantoic cavity is reduced to a narrow compressed canal, appearing in sections as a mere slit, lined by greatly flattened entodermal cells. This narrow canal opens distally into the cavity of the vesicular portion of the allantois, which is likewise lined by a thin layer of flattened entoderm. The cavity of the vesicular portion is greatly compressed by the approximation of the allantoic walls, and in sections appears as a long fissure of somewhat varying breadth. One can thus readily distinguish two surfaces in this portion of the allantois—an inner or cœlomic surface and an outer or placental surface.

The mesoderm of the outer surface of the allantois is fused with the mesoderm of the serous membrane so that one can no longer distinguish between the mesenchyme of the allantois and that of the serous membrane, and not only so, one can no longer make out the ectoderm of the serous membrane as a distinct and independent layer, the mesenchyme on the outer aspect of the allantoic cavity apparently standing in direct connection with the uterine mucosa. It seems more probable from my preparations that the ectoderm of the serous membrane has fused with the uterine mucosa than that it has disappeared in its entirety. However, my observations on this point are by no means complete, and the

question as to the fate of the ectoderm may be left undecided for the present, especially since I have within the last few days received from Mr. A. G. Hamilton a pregnant uterus of *P. obesula* containing an unattached blastodermic vesicle. The examination of this material will, I trust, throw light on the point in question, and also on certain other points in connection with the structure of the wall of the pregnant uterus.

As a consequence of this union of foetal and maternal tissues the uterine wall exhibits certain structural modifications. The layer of columnar epithelium which forms the inner lining of the non-pregnant uterus can no longer be distinguished. It has degenerated apparently over the whole extent of the inner surface of the uterus. Also there are present a short distance below the surface of the mucosa, groups of large oval or rounded nuclei, which, in the region of the placental connection are larger and stain much deeper than in the remaining portions of the uterus. These groups of nuclei are probably derived by proliferation from the lining epithelium of the uterus. The uterine glands are large and well developed, their epithelial lining showing no signs of degeneration.

The placenta is supplied with foetal blood by the allantoic vessels, which consist of a large vein, on either side of which is a small artery. These three vessels extend unbranched in the allantoic stalk. At its distal end the arteries branch out on the inner or celomic surface of the vesicular portion of the allantois, while the allantoic vein is formed by the union of two main factors which accompany the main arterial vessels. The latter branch in a dichotomous manner on the inner surface of the allantois, each arterial branch being accompanied by a venous trunk as is characteristically found in the allantois. These vessels ramifying on the inner surface of the vesicular portion of the allantois can be traced round into the mesenchyme of the outer surface, and there they break up into capillaries. The capillaries become closely applied to the surface of the uterine mucosa and form with it a somewhat irregular interlocking system, since they dip down into the substance of the mucosa to form short villous

processes. The uterine mucosa is very richly supplied with blood, the maternal capillaries forming a network on and near the surface of the mucosa, so that foetal and maternal blood are thus brought into very close relation, readily allowing of transfusion. The allantois of *Perameles* is thus functional both as a respiratory organ and as an organ of nutrition—a distinct advance upon the (according to Semon) purely respiratory function of the organ in *Phascolarctus*.

In view of this discovery of a true allantoic placenta of the discoidal type in *Perameles*, the Marsupialia as a class can no longer be included among the Aplacentalia and the, up to this, universally recognised character of Marsupials “no allantoic placenta” likewise no longer holds good.

The Macropod embryos available for examination consist of intra-uterine embryos of *Macropus parma*, *M. ruficollis*, *M. robustus*, and *M. major*. In this note it need only be mentioned that I am able to confirm Semon's belief that in the arrangement of their foetal membranes Macropods would be found to conform to his first type, as exemplified by *Aepyprymnus*, in which the allantois never comes into any connection with the serous membrane.

I desire to tender my sincere thanks to Prof. J. T. Wilson for many valuable suggestions during the course of my work.

EXPLANATION OF PLATE.

Diagram of the foetal membranes of *Perameles obesula*.

The ectoderm is indicated by a thin line, the mesoderm by a thick line, and the entoderm by a dotted line.

Reference letters.

all.c., allantoic cavity; *all.st.*, allantoic stalk; *amn.*, amnion; *cæ.*, extra-embryonic coelom; *mes.*, mesenchyme of outer surface of allantois fused with mesenchyme of serous membrane; *pro.*, prokalymma of Semon; *s. t.*, sinus terminalis; *ut.*, uterine wall; *y.s.*, yolk sac; *y.s.w.*, invaginated portion of yolk sac wall.

DESCRIPTIONS OF SOME NEW SPECIES OF PLANTS
FROM NEW SOUTH WALES.

BY J. H. MAIDEN, F.L.S., AND R. T. BAKER, F.L.S.

(Plates L.-LIII.)

LEGUMINOSÆ.

DAVIESIA RECURVATA, sp.nov.

(Plate L.)

A small shrub with erect branches, hirsute, branchlets terete, *not slender*.

Leaves very rigid, small, appressed, numerous, lanceolate, articulate, thick with recurved margins, the midrib only showing at the base on the underside, acuminate, gradually tapering to a straight rigid pungent point; usually about 2 lines long, rarely 4 lines, mostly under a line in breadth, often glabrous on the underside which has a scurfy appearance; the hairs on the upper surface have a basal gland.

Flowers solitary or clustered on filiform pedicels, either shorter or longer than the leaves. Bracts prominent.

Calyx under 1 line long, the turbinate base short, teeth not long, the two upper ones truncate and rather broader than the others, united at the base. Standard about $1\frac{1}{2}$ times as long as the calyx, dark coloured. Keel short, incurved.

Pod not seen.

Analysis showing its relation to cognate species :—

D. filipes. Branches hirsute. Leaves oblong or oval-oblong, not reticulate, straight-pointed, under $\frac{1}{2}$ in. *Shortly* pungent-pointed. Bracts very small.

D. recurvata, sp.nov. Branches hirsute; leaves lanceolate, much acuminate, recurved margins under 4 lines (mostly 2); bracts prominent.

D. squarrosa. Leaves cordate, ovate, much acuminate, usually under $\frac{1}{2}$ in. long; pedicels filiform.

This species differs from *D. filipes* with which it has greatest affinity, principally in having more acuminate and smaller leaves, with revolute margins; also in its smaller flowers, and in the upper teeth of the calyx being scarcely if at all united, as well as in possessing prominent bracts.

The calyx is similar to that of *D. squarrosa*, but the leaves entirely differ from that species.

Hab.—Taloobie, Bylong Creek, Goulburn River, N.S.W. (R.T.B.)

We have proposed the specific name from the recurved margins of the leaves.

ACACIA BAEUERLENI, sp.nov.

(Pl. LI.—right division.)

A shrubby *pubescent* plant of about 3 to 7 ft. as seen; generally 3 to 5 ft., throwing out numerous “switch-like” branchless stems *from the ground*.

Branchlets few, hoary pubescent, angular, mostly subtended by a phyllode, with very prominent decurrent lines.

Phyllodia rigid, mostly about 6 inches long, narrowed at both ends, terminating in a straight recurved pungent point, broadest in the middle, where they are 4 to 5 lines broad, rarely slightly inclined to falcate, coriaceous; veins parallel, numerous, very prominent on both sides, 3 or 4 more distinct than the others, the finer veins occasionally anastomosing. Gland slightly removed from the base, not prominent. Stipules small, about 1 line long, deciduous.

Peduncles solitary, opposite, about 9 lines long, pubescent, bearing a comparatively large, dense, globular head of from 30 to 40 flowers, closely packed, the calyces almost cohering, mostly 5-merous.

Calyx turbinate, lobes obtuse, ciliate, less than half as long as the corolla, more or less hairy, eventually separating into spathu-

late distinct sepals. Petals glabrous, often with red markings. Stamens long and very numerous, filaments white, anthers green.

Pod straight, $3\frac{1}{2}$ to 4 lines long, 3 to 4 lines broad, pubescent, the margins thickened, white and nerve-like.

Seeds oblong, longitudinal, funicle folded 3 or 5 times on itself, and not thickened under the seed.

Hab.—New Italy, N.S.W. (W. Baeuerlen).

Analysis showing affinities to and differences from cognate species :—

Phyllodia linear-lanceolate, 3- or more nerved. Petals smooth or with prominent midribs.

Sepals united. Seeds longitudinal. Peduncles short. Phyllodia under 3 lines.

Pod curved *A. lanigera*.

Peduncles long. Seed oblique and longitudinal. Phyllodia 5 to 6 ". Pod straight, funicle 4 fold, not thickened under the seed.....

A. Baeuerleni.

Peduncles short. Seed oblong, oblique, transverse. Phyllodia $1-1\frac{1}{2}$ " long, funicle 4 to 5 folds, not thickened.....

A. phlebocarpa.

Peduncles short (3"). Seeds compressed globular, longitudinal, funicle 1 fold, thickened under the seed

A. Simsii.

We have placed this *Acacia* in the *Pungentes* series of Bentham, and, if rightly so classified, it stands alone in the length and size of its phyllodes, which far exceed in length and breadth that of any other species of the group.

The pungent point of the phyllodes is not always straight, but generally so, and as the phyllodes are certainly rigid, these two points decided us in preferring to place it in the *Pungentes* to the *Plurinerves*.

It bears a general resemblance to *A. Simsii* (Fig. Muell. Ic. Aust. Acacias) and perhaps also to *A. lanigera*, except for the larger phyllodes.

The venation is certainly more like that of the latter species, as is also the vestiture, but the long peduncles, phyllodes and straight pod remove it far from that species. If there were any varietal forms it might perhaps be made a variety of *A. lanigera*, but as specimens of that species obtained from the interior of the Colony and from many parts of the Dividing Range show no perceptible variation, it is impossible to look upon our plant as a variety. We may also mention that the sucker or switch-like appearance of the stems of *A. Baeuerleni* in no way resembles the close thickset shrub *A. lanigera*. The bracteoles appear also to be wanting or are very deciduous.

The individual flowers and head are also larger than those of *A. lanigera*, while the stamens have white filaments and light yellow anthers.

The pods also show no tendency to curve.

Had it come under the *Plurinerves*, then its affinities would be with *A. elongata* and *A. Simsii*, from which species it differs mostly in the shape of the phyllode, length of peduncle, calyx, and shape of seed and aril.

Dedication.—This species is named after Mr. William Baeuerlen, the painstaking botanical collector of the Technological Museum.

ALBIZZIA (PITHECOLOBIUM) MUELLERIANA, sp. nov.

(Pl. LII.)

A tree glabrous in all its parts, height about 50 to 70 feet, as seen, diameter 2 feet, locally known as "Ash."

Pinnæ one pair, rarely two pairs, the common petiole mostly under one inch, each rhachis often short, rarely exceeding two inches. Gland wanting. Leaflets glabrous, usually one pair subtended by an odd one, exceptionally composed of three or four leaflets irregularly placed along the rhachis, ovate acuminate, obtuse, or oblanceolate, acuminate, the cuneate base narrowing into a distinct hairy or pubescent petiolule, articulate with the rhachis; 1 to 5 inches long, reticulately penniveined on both sides, but much more prominently so on the underside, paler above.

Panicles in the upper axils or loosely racemose, exceeding the leaves; peduncles flat or angular. Flowers up to about 15 in globular umbels, sessile. Calyx glabrous, 2-3 lines long, shortly toothed, ciliate, campanulate or cylindrical. Corolla exceedingly short in the bud, glabrous, 2-3 lines long, equally 5-lobed. Stamens green, united below the lobes, 9 lines long. Pistil glabrous. Style elongated, 1 inch long. Ovary surrounded at the base by a cup-shaped gland.

Pod *thick, fleshy*, terete, 2 to 4 inches long, 3 to 4 lines broad, twisting when perfectly ripe and eventually becoming very hard, valves dark red outside, orange-coloured inside.

Seed black, imbedded in the thick fleshy interior of the pod, about 2 or 3 lines long.

Hab.—Marshall Falls, Alstonville, and also Tintenbar, Richmond River; also Mullumbimby, Brunswick River, N.S.W. (W. Baeuerlen).

This species has closest affinity with *Albizzia* (*Pithecolobium*) *Hendersoni* and *A. ramiflora*—a specific name, by the way, which would apply equally well to all our *Pithecolobiums* and *Albizzias*.

It is distinguished from the former species by its fewer leaflets, which are not at all oblique and are of a much thinner texture and of a lighter colour; the stamens also are shorter.

From *A. ramiflora*, with which it has closest affinity, it is not so easily distinguished, as the description of that species is from imperfect material. It, however, differs from it principally in the size of leaflets and flowers and the petioles not being decurrent.

It can be recognised from *A. pruinosa* by its sessile flowers and fewer and larger leaflets.

The most remarkable feature about this species is the full development of the calyx before the appearance of the corolla, which at its maturity about equals the calyx in length. This fact does not appear to have been recorded in any of the published descriptions or delineations of Australian species.

The following analysis will show its relative position:—

A. Hendersoni. Leaflets very oblique, flowers on very short stalklets, corolla twice as large as the calyx.

A. Muelleriana, sp.nov. Leaflets distinctly petiolate *articulate*, equal-sided, ovate acuminate, corolla shorter than the calyx. Style under 1 inch.

A. ramiflora. Leaflets large, obovate, *shortly decurrent*, corolla very long. Style 4 inches long.

Dedication.—In honour of Baron Sir Ferdinand von Mueller, K.C.M.G., the distinguished Government Botanist of Victoria.

We have used the generic term *Albizzia* instead of *Pithecolobium* in deference to the advice of Baron von Mueller, who writing us on the subject, says :—

“If you look through the Iconography of Australian Acacias and allied genera, you will find that the characters, on which *Pithecolobium* by my celebrated friend Martius was founded, find their counterpart in *Acacia*, and that accordingly also from *Acacia* a number of species would on the same grounds require to be separated. Indeed *Vachellia* has been distinguished by a pithy pod for *A. Farnesiana*, but by common consent *Vachellia* became discarded. It was not on light considerations that I overthrew in the Journal of Bot. for 1872 *Pithecolobium*, at all events for the Asiatic and Australian species, there being absolutely no difference between these genera. Whether *Pithecolobium* can be maintained for any S. American species I cannot positively assert. It was founded on species with somewhat succulent pods, such as the monkeys there feed on. Hence the name. But no difference in other respects seems to occur among the *Albizzias* of the eastern and western world. Furthermore, the well known genus *Gleditschia* in Leguminosæ contains species with dry and succulent legumens. What I said of *Gleditschia* applies similarly to the still closer allied genus *Prosopis*.”

COMPOSITÆ.

PODOLEPIS RUBIDA, sp.nov.

A slender, glabrous (or slightly woolly at the base) divaricate perennial, from 1 to 3 or more feet in height.

Leaves linear, 2 inches long at the base and decreasing in size on the stems on some specimens, while in others 4 inches long at the base, decreasing to 2 inches long on the stem, the upper ones stem-clasping and decurrent, tapering from the base upwards, margins recurved, glabrous above, woolly underneath, but midrib prominent, basal leaves with a loose cottony down.

Flower heads small, on filiform peduncles. Involucre hemispherical, rarely exceeding 3 lines, the scarious laminae of the bracts rugose, imbricate, ovate or acuminate, decurrent on the whole length of the claw of the inner row of bracts; the claw of the outer bract very short but gradually lengthening to a long linear one on the penultimate or innermost row but one; the claws glandular. Florets yellow, all exceeding the involucre, the outer ones about 3 lines long, ligulate, *shortly 3- or 4-lobed*.

Pappus bristles fine, not thickened upwards, shortly barbellate. Achenes glabrous.

Hab.—Bathurst, N.S.W. (W. J. C. Ross).

Analysis showing differences from cognate species :—

Involucre large, laminae very acute
 acuminate, not rugose. Stem
 leaves slightly decurrent, basal
 leaves oblong lanceolate *P. acuminata*, R.Br.

Involucre small, about 3 lines, outer
 laminae very obtuse, inner ones
 acuminate, *rugose*, stem leaves
 decurrent, basal leaves linear ... *P. rubida*.

Involucre 6-8 lines, laminae very
 acute, not rugose; annual..... *P. canescens*, A. Cunn.

It is not easy to indicate the relative position of this species in Bentham's classification of *Podolepis*. It is placed between the two above mentioned species, but it could with perhaps equal fitness be also placed between *P. Lessoni* and *P. Siemssenia*. The large flowers and large basal leaves of *P. acuminata* at once separate it from that species, as do also the acute laminae and deep incision of the ray florets.

It is easily recognised from *P. canescens* by its obtuse *laminæ* and smaller involucre as well as by the shape of the leaves, and in being a much slender and taller plant, and almost glabrous.

Of all the species in this genus it has the greatest superficial resemblance to *P. Lessoni*, and could easily be mistaken for that species, its chief characteristic difference being its much longer and decurrent linear-lanceolate leaves, rugose scarious *laminæ*, and the presence of the basal bracts of the involucre.

P. Siemssenia stands apart from it principally by its decurrent, smooth *laminæ*; "not perceptibly barbellate pappus-bristles;" smaller non-decurrent stem leaves; absence of scarious scales on the peduncles and its shining bracts.

Its specific name has reference to the colour of its stems.

HELICHRYSUM TESSELATUM, sp.nov.

(Plate LIII.).

An erect shrub of several feet, often with thick stems which always retain the prominent decurrent lines of the leaves, the branches closely woolly tomentose.

Leaves narrow-linear with recurved or revolute margins, about $\frac{3}{4}$ of an inch long including the decurrent part, which equals about half its entire length, woolly tomentose underneath, smooth and shining above, rarely with any asperities, obtuse or with a recurved point.

Flower heads numerous, larger than those of *H. diosmifolium*, in rather loose terminal corymbs, sometimes measuring 4 to 5 inches.

Flower heads straw-coloured on woolly white, stouter pedicels than the allied species, larger and less numerous than those of *H. diosmifolium*. Involucre hemispherical or ovoid-turbinate, 3 lines in diameter, or a shade longer than broad, the bracts obtuse, concave, compact, straw-coloured, with spreading tips, the outer ones slightly woolly below the scarious tips. Florets about 35 to 40, a few of the outer ones females.

Achenes hairy. Pappus-bristles slender, serrulate, not thickened upwards.

Hab.—Bylong, Murrumbo (Goulburn River), N.S.W.

Analysis showing differences from allied species:—

Involucral bracts more or less scarious, obtuse, without any or with scarcely conspicuous white tips.

Involucre ovoid-turbinate. Florets above 15. Achenes glabrous or papillose.

Leaves not decurrent..... *H. cinereum*.

„ shortly decurrent *H. bracteolatum*.

„ much decurrent... *H. tessellatum*.

(The specific name being given in allusion to the strikingly tessellated appearance of the stem, owing to the scars of the bases of the leaves).

This species when first seen in the field has the general facies of *H. diosmifolium*, but its specific differences are readily apparent.

The long, prominent persistent decurrent lines on the old stems, its scarious yellow bracts and larger flowers at once establish its identity.

It approaches slightly *H. adnatum* in having the raised decurrent lines persistent after the leaves have fallen, but its larger flower heads and the more numerous florets, scarious and spreading tips and also the larger and thicker leaves easily distinguish it from that species.

Its nearest affinity is perhaps with *H. bracteolatum*, but this species has *shortly* decurrent leaves and only 15 to 20 florets.

HELICHRYSUM BREVIDECURRENS, sp. nov.

A tall, heath-like shrub, in general appearance resembling *H. diosmifolium*, the branches and underside of the leaves cottony white.

Leaves narrow linear with a recurved point, revolute margins which are decurrent on the stem but not so much as *H. decurrens*,

shining above, but with less asperity than *H. diosmifolium*, about 6" long, cottony white underneath.

Flower heads hemispherical or slightly turbinate, rather larger than those of *H. diosmifolium* but less than those of *H. decurrens*, numerous in a terminal corymb.

Involucre *hemispherical*, under 2 lines in diameter, the bracts obtuse, concave, all the outer ones scarious, straw-coloured, with scarcely spreading tips, the inner circle yellow with paler tips. Florets about 25-30. Achenes hairy. Pappus-bristles serrulate, not thickened upwards.

Hab.—Murrumbo, Goulburn River, N.S.W.

Analysis to show cognate species:—

Involucral bracts with concave, erect or loose but *not spreading* obtuse tips, all or the inner ones white or pink.

Leaves not decurrent Florets 20 *H. diosmifolium*.

Involucral bracts more or less scarious, obtuse, without any or with scarcely conspicuous white tips.

Involucre *ovoid-turbinate*, narrow.

Florets about 15. Leaves shortly decurrent *H. bracteolatum*.

Involucre hemispherical. Florets

25 to 30. Leaves shortly decurrent *H. brevidecurrens*.

Involucre hemispherical. Florets

35 to 40. Leaves very decurrent *H. tessellatum*, sp. nov.

As will be seen in the analysis, it has greatest affinities with *H. bracteolatum*, whilst it also approaches *H. tessellatum* in the general resemblance of the involucre, but differs from it in the shortly decurrent and more numerous leaves and smaller flower heads. From *H. adnatum* it is distinguished by the shape of the involucre and number of florets, and the pappus-bristles being not thickened upwards, and its larger heads.

BIGNONIACEÆ.

TECOMA BAILEYANA, sp.nov.

(Pl. LI.—left division.)

A tall woody climber, glabrous. Leaves pinnate with 7 to 9 leaflets, sometimes exceeding 2 feet, opposite or in whorls of 3 or 4, petiole 3 inches long.

Leaflets oblique, usually 7 but sometimes 9, large, about 5 inches long and over 2 inches broad, ovate acuminate, rounded at the base or shortly tapering into an exceedingly short petiole, pale coloured underneath, reticulations very prominent below but less marked above, margins slightly recurved, articulate on the rhachis.

Flowers in axillary racemes or interrupted spikes from 3 to 15 inches long of a cream colour, but touched inside on the lobes and throat with a delicate shade of pink. Calyx glabrous, 5-toothed, of a purplish-brown colour. Corolla-tube incurved, 6 lines long, not dilated upwards, but perfectly cylindrical, covered inside and out with minute glandular hairs or processes very numerous on the lobes; the lobes almost equal, acuminate-obtuse. Stamens 4, in pairs included in the tube. Pistil longer than the stamens, style with 2 short ovate stigmatic lobes.

Capsule unknown.

Hab.—Mullumbimby Creek, Tweed River, N.S.W. (W.B.)

Analysis showing the differences of this plant from cognate species:—

Flowers in a long raceme or spike,	
corolla incurved, not dilated up-	
wards, 1 line in diameter. Leaf-	
lets about 5 inches	<i>Tecoma Baileyana.</i>

Flowers in a loose panicle, corolla	
slightly incurved and dilated up-	
wards, 3 lines in diameter, leaflets	
variable, not exceeding 3 inches .	<i>T. australis.</i>

Flowers compact, corymbose, corolla
about 1 inch in diameter..... *T. jasminoides*.

Corymbs of 6 to 8 flowers, corolla about
2 inches long, purplish *T. Hillii*.

The small tubular cream-coloured flowers of this species give it an appearance quite distinct from the other well-known Australian *Tecomas*, so that it is very easy to recognise in its native habitat.

Our idea to make this a variety of *T. australis* was overcome by the fact that *T. australis* with all its variations of foliage preserves, wherever found, a very constant flower, which is very distinct from this new species.

As *T. australis* is also found at Mullumbimby, it can readily be compared on the spot with the new species.

Besides its distinctive flowers the foliage is also characteristic. The foliage of *T. australis* with all its variations of coast, tableland and far interior specimens in no way resembles the large, coriaceous leaflets of this new species.

The calyx of purplish-brown may also be noticed.

We regret that we have not succeeded in obtaining the fruit, but there appears very little hope of obtaining any from the plants from which this diagnosis is made, as they are so situated on a vertical bank that all the fruit must inevitably fall into Mullumbimby Creek.

Discovered on the banks of Mullumbimby Creek by W. Baeuerlen, and who, although collecting systematically in this district for over four years, has only seen one plant.

Named in honour of Mr. Fred. Manson Bailey, F.L.S., the Government Botanist of Queensland.

EXPLANATION OF PLATES.

Plate L.

Daviesia recurvata.

- Fig. 1.—Flowering twig.
- Fig. 2.—Individual flower.
- Figs. 3 and 4.—Standard.
- Fig. 5.—Keel.
- Fig. 6.—Wing.
- Fig. 7.—Pistil.
- Fig. 8.—Leaves.

All enlarged except No. 1.

Plate LI.—right division.

Acacia Baeuerleni.

- Fig. 1.—Flowering twig.
- Fig. 2.—Bud.
- Fig. 3.—Individual flower.
- Fig. 4.—Pistil.
- Figs. 5, 6, 7.—Bracts.
- Fig. 8.—Pod showing seed *in situ*.
- Fig. 9.—Portion of phyllode magnified.

All enlarged except Figs. 1 and 8.

Plate LII.

Albizzia (Pithecolobium) *Muelleriana.*

- 1.—Foliage.
- 2.—Flowering twig.
- 3.—Individual flower.
- 4.—Pistil and gland.
- 5.—Immature pod with part of valve removed to show seeds *in situ*.
- 6.—Ripe pod—seeds removed.

Plate LIII.

Helichrysum tessellatum.

Fig. 1.—Flowering specimen.

Fig. 2.—Floret.

Fig. 3.—Section of upper part of floret tube.

Fig. 4.—Pistil.

Fig. 5.—Bracts.

Fig. 6.—Portion of stem showing decurrent margins of the leaves on it.

All enlarged except Figs. 1 and 6.

Plate LI.—left division.

Tecoma Baileyana.

Fig. 1.—Flowering raceme.

Figs. 2, 3, 4, 5.—Individual buds and flowers.

Fig. 6.—Section of corolla, showing disposition of pistil and stamens
(enlarged).

Fig. 7.—Part of leaf showing leaflets.

OBSERVATIONS ON THE EUCALYPTS OF NEW
SOUTH WALES.

BY HENRY DEANE, M.A., F.L.S., &C., AND J. H. MAIDEN, F.L.S., &C.
(THE ILLUSTRATIONS BY R. T. BAKER, F.L.S.)

PART I.

(Plates LIV.-LVII.)

INTRODUCTORY.

The two great works on the genus *Eucalyptus* are the "Flora Australiensis," (Vol. iii. pp. 185-261); and Baron von Müller's Monograph "Eucalyptographia," a quarto, with illustrations of one hundred species.

For some years past we have been giving particular attention to those species which occur in New South Wales, and, as the result of our investigations, both in the field and from examination of specimens, dried or otherwise, we are in a position to submit some notes which we believe will usefully supplement the works above referred to. The subject is a vast one, and we hope to add to these notes on particular species from time to time. We hope to do for the Eucalypts of New South Wales what Howitt has done for those of Gippsland in his paper "The Eucalypts of Gippsland," (Trans. Roy. Soc. Vict., Vol. ii., Part 1, pp. 81-120).

We trust our facts and suggestions will be found useful as far as they go; they are obviously incomplete in many directions, but we trust that they will lead to the taking of additional observations, and the collection of additional material by botanists and others in every district of the Colony in which Eucalypts are found.

EUCALYPTUS STELLULATA, Sieb.

Introductory.—The name is rather happy, and refers to the disposition of the buds, which remind one of a little star or rosette.

Vernacular names.—“Black Sally,” Gippsland and Southern New South Wales at least as far north as Goulburn; also New England Ranges. “Black Gum,” Bombala.

The above names have been given on account of the rough, hard black bark on the butt.

“Sally Butt,” between Bathurst and Orange. The name “Sally,” without a qualifying adjective, is in use at Bombala, Boro, Braidwood and Yass. The name is in allusion to the species being often found on the banks of streams, like a sally (sallow or willow). “Olive-green Gum” (Leichhardt). “Green Gum,” County of Argyle and Blue Mountains (Macarthur; New England and high land near Braidwood (Dr. Woolls). “White Gum,” County of Argyle and Blue Mountains (A. Cunn.). “Blue Gum” (Forester Mecham, Tumut). “Lead Gum,” County of Argyle and Blue Mountains; Berrima (Macarthur); Hartley and Mudgee (Woolls).

All the above names, “Olive-green Gum,” &c., are attempts to describe the appearance of the smooth portion of the bark, which varies from white with a bluish or lead-coloured cast to even a dirty olive-green.

The species is a stunted gum growing at high elevations, smooth-barked (except at the butt), and looking as if it were blue or lead-coloured with the cold. There are so many White Gums that we think the name “Lead-coloured Gum” is a useful one, while “Black Sally” is better still, and the most widely spread of existing names.

It is called “Muzzle-wood” in Gippsland, but the meaning of the name is unknown to us.

Seedling or sucker leaves.—Ovate-acuminate, larger in size and thinner in texture than the mature leaves. The average dimensions of some seedling leaves in our possession are $3\frac{1}{2}$ inches long by a width of one half this. (Pl. liv., figs. 7-9.)

Mature leaves.—The tips are often hooked like those of *E. coriacea* and of some forms of other species, e.g., *amygdalina*. The leaves of both species when dry are smooth and usually show

black dots (like *E. punctata*), while the parenchymatous tissue is more or less channelled. These appearances are also seen in some forms of *E. amygdalina* and other species, and we draw attention to them in order that too great importance be not attached to them. In *E. punctata* these black dots were considered to indicate a specific difference.

The shape of the leaves is lanceolate to broadly lanceolate. The leaves are smaller than those of *E. coriacea*. The venation springs from the petiole, and the primary veins are prominent and roughly parallel to the midrib.

Timber.—Pale coloured, rarely free from gum-veins, warps seriously, a sound log of any size very rare; of little value for purposes other than fuel. Timber that shrinks much in drying may do so regularly or irregularly. Those of the first class have, when dry, practically the same shape as the original piece, but those of the second class take on irregular shapes. The timbers of *E. stellulata* and *E. coriacea* belong to the latter class.

Variations from type.—var. *ANGUSTIFOLIA*, Benth. (Syn. *E. microphylla*, A. Cunn. partly) with small, narrow leaves.

Highest parts of the Blue Mountains, *e.g.*, Blackheath and Mt. Victoria. Occurring with the ordinary form in the Kanimbla Valley. See fig. 8.

Range.—Typical form.—The tops of the ranges on the N.S.W.-Victorian border, thence following the Dividing Range and its spurs at least as far north as the New England Ranges, and as far west as 18 miles west of Bathurst, on the Silurian; also at Rylstone. We have specimens from these localities, but it may be reasonably expected to be found further north and further west, in mountainous districts.

EUCALYPTUS CORIACEA, A. Cunn.

Introductory.—This is the name given in the *Flora Australiensis*. Sieber's name *E. pauciflora* has doubtful priority, but it is so inappropriate (no Eucalypt flowering more freely than this), while Cunningham's name is remarkably appropriate, that we feel it our duty to adopt the name *E. coriacea* for this species.

Vernacular names.—One of the “White or Cabbage Gums,” but not to be confused with *E. hæmastoma*, var. *micrantha*, which goes by the same names. Its usual name with us is “White Gum,” though it is very frequently called “Cabbage Gum” also. The names “Flooded Gum” and “Peppermint” under which this species is known in Victoria (B. Fl.) would not appear to be in use in this colony. As regards the latter name, we suggest that it has arisen from the fact that a form of *E. amygdalina* growing in the south-eastern part of the colony resembles *E. coriacea* in fruits and perhaps in other respects. We have evidence pointing in this direction.

The species goes under the name of “Weeping Gum” in Tasmania, owing to its scrambling habit; the name is also in use at Uralla, N.S.W. At Glen Innes it is locally known as “Tumble-down Gum,” also by reason of its aspect.

“Glassy Gum” is a name in use at Guyra, on account of the vitreous appearance of the bark.

“White Sally” is a name in use at Queanbeyan.

Seedling leaves.—Broader than the mature leaves; more or less ovate.

Mature leaves.—Coriaceous, yet often succulent, and hence eaten by stock. They are comparatively large, six inches being a common length, while five inches is perhaps under the average. The width is usually about $1\frac{1}{2}$ inch. They are usually shiny, but in the coldest districts often glaucous. The venation is as stated under *stellulata*, and in this respect not only shows affinity with that species but also with *amygdalina*, particularly through the variety *latifolia* of that species.

Timber.—Pale coloured, full of gum veins; warps a good deal.

Variations from type.—Following are notes on Eucalypts which more or less depart from the typical form of *E. coriacea*:—

(a) *E. coriacea* becomes less glaucous in the Delegate district; bark scribbled like *E. hæmastoma*. The young leaves are larger and thinner than those of the type.

(b) Leaf about $4\frac{1}{2}$ inches long, straight or nearly so, *i.e.*, seldom falcate, fruit more nearly sessile. Unripe fruits nearly hemispherical; ripe fruits contracted at the orifice and ovoid. Sometimes glaucous, and apparently connecting with variety *alpina*. The bark is smooth, grey and striped, and is marked by scribbles similar to those of *E. hæmastoma*. The tree is in fact a good deal like that of a large-fruited variety of *E. hæmastoma*, to which we shall subsequently allude, but the venation and consistence of the leaves (not to mention other points) are those of *E. coriacea*.

Cooma District. Cooma and Braidwood Road.

(c) Var. *alpina*, F.v.M. (B. Fl. iii. 201). Leaves short and nearly straight. Flowers rather smaller and peduncles shorter.

Mountains on Macalister River, Vic. (B. Fl.).

Specimens of this variety from Mt. Kosciusko, in our own Colony, are very glaucous. Leaves 2 inches long, or a little more. (Pl. liv., figs. 2-3.)

Range.—Usually at fairly high elevations, preferring undulating, grassy country in the ranges and high table-lands. Found practically in the same districts as the preceding species.

E. AMYGDALINA, Labill.

The various forms have leaves which have a strong (sometimes very strong) odour of peppermint, to which circumstance they owe their commonest vernacular name. *E. piperita*, *E. sieberiana* and *E. stuartiana* possess an odour of a somewhat similar character. *E. piperita* and *E. stuartiana*, especially in certain districts, are known by the name of “peppermint,” but *E. amygdalina* is the tree which is most usually understood by that name.

We propose to classify the various New South Wales forms we deal with on the present occasion as follows:—

Sucker or seedling leaves narrow.

1. The typical species, comprising a number of forms which do not, at first sight, appear to be connected with each other.

2. Var. *radiata*, containing the tree usually known as "River White Gum."

Sucker or seedling leaves broadish.

3. Variety *latifolia* (*nobis*), comprising some of the broad-leaved forms.

There are other forms, at present placed under *amygdalina*, but as our specimens or observations in regard to them are incomplete, we prefer to postpone consideration of them.

1. Typical *E. amygdalina*.

Introductory.—In the case of such a protean species as *E. amygdalina*, it may be useful, and it is certainly interesting, to note what the definition of the species really was, as by different authors the description has been modified very considerably.

The original specimen described by Labillardière came from Tasmania. The following is Don's translation of the species description given in DC. Prod. iii. 219 :—

"Lid hemispherical, nearly mutic, shorter than the cup; peduncles axillary and lateral, nearly terete, length of the petioles; umbels 6-8 flowered, nearly capitate; leaves linear-lanceolate, attenuated at the base, and acuminate mucronate at the apex. Leaves 3 inches long, and 3 lines broad, some unequal at the base, and some equal. Petioles and peduncles 3 lines long. Fruit globose, size of a grain of pepper."

Vernacular names.—Peppermint or Messmate are the most widely used names, and they are perhaps indiscriminately employed. Perhaps the former name is more prevalent as far north as Mittagong and the Blue Mountains, and the latter in New England, but the two names are often employed in the same district for the same tree. Some other local names will be found under *Range*.

Bark.—This is the least variable characteristic; it is sub-fibrous, although on the one hand it sometimes approaches the character of a Stringybark, on the other hand it is often of a

shorter character, resembling the more friable varieties (of barks) of *E. hemiphloia*. It is almost undistinguishable from the bark of *E. piperita*. It is usually of a dark, dirty grey colour. Occurs only on the trunk, or at most on the largest branches; the branches usually quite smooth.

Seedling or sucker leaves.—Opposite, narrow-lanceolate. Probably all the forms have the twigs more or less rusty glandular.

Mature leaves.—This species varies in the size, shape and texture of its leaves. The usual shape is lanceolate, or even broadly-lanceolate, but some forms are linear-lanceolate or even nearly linear, comparatively thick, and the veins very oblique at the base, not prominent, *e.g.*, specimens from Mittagong, and also a tree known as “Silver-top” at Nimitybelle in the extreme south of the Colony. Sometimes the foliage is quite dense; in other cases it is sparse.

This would appear to be the form most generally employed in the manufacture of Eucalyptus oil in this Colony. It is so chosen because its leaves contain an unusually large percentage of oil, which is, however, not at present a favourite in European markets owing to the almost entire absence of cineol (eucalyptol) and the very large percentage of phellandrene. The above remarks are more or less applicable to all forms of *amygdalina*.

Buds —The shape of the operculum of the western and northern forms (Mt. Victoria and New England) is blunt, being nearly hemispherical; those of the southern forms in our collection are more pointed.

The variability in the shapes of the operculum in *E. amygdalina* is brought out in the plate (comprising two forms) in the “Eucalyptographia.”

Fruits.—Although in the original description of the species the flowers are in heads of 6-8, those of some of our N.S.W. forms have at least twice as many, and some perhaps nearly as many as those of the variety *radiata*. None of our specimens have the fruits as pear-shaped as depicted in the drawing of the left-hand

specimen of *E. amygdalina* in the "Eucalyptographia." (See var. *latifolia*). Following is a general description of them:—

The fruits are of a pilular shape, though with some slight tendency to pear-shape. They are wide at the mouth and almost hemispherical, somewhat in the manner of *E. acmenoides*. Bentham's "sub-globose truncate" applies to many of the forms.

The tips of the valves are sometimes slightly exerted.

Timber.—Pale-coloured (nearly white) when newly cut, but drying to a pale brown. Often liable to gum veins, which tend to form thin concentric rings. Of inferior durability and strength as a very general rule, but we have some apparently well authenticated instances of the durability of this timber for posts and shingles in the New England District.

Range.—Extending from Victoria along the various coast mountain ranges and their spurs at least as far north as New England, and westerly as far as the western slopes of the Blue Mountains.

Some specific localities in this Colony may be stated as follows:—Mountain Top, near Nimitybelle (Silver Top). Braidwood District. Goulburn District generally. At Marulan, Eucalyptus oil is distilled from this form (Peppermint). Kangaloon (White-topped Mountain Ash). Hill Top and Mittagong. Mt. Wilson. Mt. Victoria (Narrow-leaved Peppermint). New England (Messmate). The specimens from the last two localities are to all intents and purposes identical.

2. Var. *radiata* ("River White Gum").

Introductory.—We have a fairly distinct tree which goes under the names of "White Gum," "River Gum," "River White Gum," "Ribbon Gum," and even "Narrow-leaved Peppermint."

Its favourite habitat is on the sides of gullies, or on the steep banks of rivers, often some distance from the bed of the river or creek, but usually (perhaps always) on a well-drained slope leading to a water-course. We have not observed the tree out of gullies.

It is often seen as a graceful sapling, but may attain the dignity of a large tree; in this Colony we have it up to 3 feet in diameter with a height of over 150 feet.

It has rather sparse, drooping foliage, which gives it, at times, something of a willow-like aspect.

Bark.—The appearance of the bark of this tree is worthy of careful record, to save confusion. It is nearly a White Gum when very young, but afterwards the bark of the upper part falls off in thin, long ribbons (hence the name Ribbon Gum), and the lower part of the trunk becomes covered, to a varying height, with fibrous bark of the character known to many as Peppermint bark.

We have not observed a tree of this variety falling strictly within the definition of White Gum, like *E. hæmastoma*, for instance; it is *nearly* a White Gum.

Sometimes, as observed near Mittagong, the lower part of the trunk of the River White Gum is of a thin scaly appearance; in trees say 12 inches in diameter, this scaliness would extend to 10 or 12 feet from the ground. This scaly appearance, which is not easy to describe, is intermediate in character between the scabrous bark of a Grey Gum (*E. punctata* or *propinqua*), and the thick scaly bark of a Bloodwood (*E. corymbosa*). As these trees increase in size, the scaliness changes into that of a hard, fibrous “peppermint-like bark” character. The branches are quite smooth.

We draw attention to this matter, as two observers might possibly obtain two series of herbarium specimens agreeing in the minutest particulars, and one observer might report his tree smooth-barked (*Leiphloia*), and the other half-barked (*Hemiphloia*).

The name given by the aborigines of the County of Cumberland, N.S.W., to the “River White Gum” used to be “Kayer-ro,” according to the late Sir William Macarthur. This accurate observer writes of it—“Of no value for timber. A small, quick-growing species, very elegant when in blossom; is found only on the immediate sandy banks of rivers; the inner bark used for tying

grafts and for other similar common purposes." Subsequently Mr. Howitt points out that the aborigines of Gippsland similarly used the bark for tying and lashing, hence their name for the tree, "Wang-gnara," which signifies "bark-string."

Vernacular names.—Already dealt with.

Bark.—Already dealt with.

Seedling or sucker leaves.—The young stems have a rusty, glandular appearance, and the leaves are very narrow.

Mature leaves.—Dealt with below. (See page 607).

Although the leaves of this form are very thin, specimens from Bateman's Bay to Wagonga are especially thin. These specimens also have unusually narrow leaves.

Buds.—See page 607.

Fruits.—Large numbers (commonly 20 and more) in an umbel, borne on rather long, often filiform pedicels. They have a very regular, radiate appearance. Mostly pale coloured when dry. Very uniform in size, 2 to $2\frac{1}{2}$ lines (barely) in diameter, and pilular in shape. Sometimes they tend to close at the orifice.

Timber.—It is a white, fissile timber, rather tough when freshly cut, but afterwards of inferior strength. It is easily worked, but not durable on exposure. It is sometimes, we believe, fraudulently or ignorantly substituted for "Mountain Gum" (*E. goniocalyx*) in the Braidwood District, with disastrous consequences to the durability of the work in which it is used, and to the reputation of that undoubtedly valuable timber.

Range.—From Gippsland, through New South Wales, throughout the southern districts, at least as far north as the banks of the Nepean in the latitude of Sydney. Subsequent inquiry will probably find that it occurs further north. It is fond of valleys; we have it from such localities as Kangaroo Valley (between Moss Vale and the coast), and from Hartley Vale (near Mount Victoria). Our specimens from the Deua (Moruya) River and Tantawanglo Mountain connect with the Gippsland ones.

Botanical position.—Having described this Gum with some detail, we now proceed to enquire into its botanical position. There is no doubt that this “River White Gum,” Bentham’s variety *radiata* of *amygdalina* (B. Fl. iii. 203), and Howitt’s form (e)* of *E. amygdalina* all come more or less satisfactorily under Sieber’s *E. radiata*. A good deal of confusion has occasionally arisen in regard to the reading of Sieber’s description. We give Don’s translation of the original Latin in DC. Prod. iii. 218, Howitt’s description of the Gippsland form, and Bentham’s definition of var. *radiata*.

“E. RADIATA, Sieb.

“Lid of calyx hemispherical, mucronate, shorter than the cupula; peduncles axillary and lateral, rather angular, and rather shorter than the petioles; flowers 15-20 together in an umbel, on short pedicels; leaves linear-lanceolate, veins very fine, confluent at the apex, and forming a nerve, which is parallel with the margin.

“Fruit globose, 3 lines in diameter. Petioles 4 lines long. Leaves 4 inches long and 6-7 lines broad.”

Mr. Howitt describes his form (e) as having:—*Leaves* narrow lanceolar falcate, attenuate at the stalk and pointed. Venation rather indistinct, the marginal vein considerably removed, and the lateral veins very longitudinal. *Umbels* on stalks as long or longer than the bud, the lid small and depressed, with a slight point. Buds numerous, 3 to 20. *Fruit* ovate-truncate, with slightly contracted orifice, compressed rather narrow rim, and small weak valves.

As described in the “Flora Australiensis,” iii. 203, the “variety” *radiata* has leaves rather broader (than the type), 3 to 4 inches long. Flowers usually more numerous, sometimes nearly 20 in the umbels. Fruit almost pear-shaped.

E. radiata, Sieb.—*Leaves* linear-lanceolate, 4" long, 6-7" broad, veins very fine, confluent at apex, forming a nerve, which is

* “The Eucalypts of Gippsland.” Trans. Roy. Soc. Vic. Vol. ii. Pt. i. p. 86, and Plate 10, figs. 1-5.

parallel with the margin. *Pedicels* short. *Buds*: lid hemispherical, mucronate. *Fruit* globose, 3 lines in diameter.

Bentham's variety *radiata* of *E. amygdalina*.—*Leaves* rather broader than type, 3"-4" long. *Fruit* almost pear-shaped.

Howitt's form (*e*) of *E. amygdalina*.—*Leaves* narrow-lanceolar, falcate. Venation rather indistinct. Marginal vein considerably removed. Lateral veins very longitudinal. *Pedicels* as long or longer than the bud. *Buds*: lid small and depressed, with a slight point. *Fruit* ovate-truncate, with slightly contracted orifice, compressed rather narrow rim, and small weak valves. (See his figure, *op. cit.*).

The "River White Gum" of N.S.W.—*Leaves*. The preceding (Howitt's) description applies very well. *Very* thin leaves. *Pedicels* rather long, often filiform. *Buds* nearly hemispherical; Howitt's description applies fairly well to this form. *Fruit* pilular (globose), very uniform in size ($2-2\frac{1}{4}$ lines in diameter), sometimes tending to close at the orifice. (Pl. lvi., fig. 3.) Often pale-coloured when dry.

Above is a comparative statement showing partial and condensed descriptions of *E. radiata*, Sieb., Bentham's variety *radiata*, Howitt's form (*e*) (both of *amygdalina*), and River White Gum.

Sieber gives the breadth of the leaves at from 6-7 lines. Most are of about that breadth, others go up to 9 lines, while we have specimens from the Deua (Moruya) River which has leaves with the exceptional width of $1\frac{1}{8}$ inches (nearly 14 lines!). Sieber gives the length of the leaves at 4 inches. These are too short as far as our River White Gum is concerned, leaves of 6 and 7 inches being common, while those of 5 inches at least are average ones. Sieber says pedicels *short*; those of the River White Gum are filiform and more than ordinarily long. He further gives the diameter of the fruit as 3 lines; we have never known it in the River White Gum to be quite $2\frac{1}{2}$ lines, really a difference of some importance when we note how marked a difference in the appearance of a small fruit half a line or more in diameter makes. Nevertheless, after careful consideration of the matter, and examination of a large number of specimens, we are of opinion that Sieber's original *radiata* was taken from a River White Gum.

Then coming to Bentham's brief definition of variety *radiata*, he states that the "leaves are rather broader than type." He has probably followed in part Hooker ("Flora of Tasmania," p. 137) in his description of *E. radiata* :—"Leaves . . . rather small, usually 3 inches long . . . narrow, sometimes very much so, though not so narrow as *E. amygdalina* usually has them." We have already shown what is the average length of the leaves of the River White Gum. As regards the breadth, the leaves of the River White Gum are usually narrower (not broader) than those of typical N.S.W. forms of *amygdalina*. As regards the fruits, Bentham's variety is "almost pear-shaped." Here again Hooker is probably followed. The latter states fruits "turbinate or obconic, rather large." Neither in size nor shape does this correctly describe our River White Gum. As showing the difficulty of dealing with *E. radiata*, we may point out that (doubtfully) Hooker (*op. cit.*) quotes five forms of it in Tasmania alone. We would like to observe that Sieber's original specimen of *E. radiata* came from N.S.W., and not from Tasmania, and it would be well to modify Bentham's brief description in the directions we have indicated, and not to follow a description of the variety made from Tasmanian forms.

We have proved that our River White Gum does not entirely agree with Sieber's *E. radiata* nor with Bentham's var. *radiata*, and our tree is so well marked that had we decided that it was expedient to recommend the restoration of *E. radiata*, Sieb., to specific rank, we should probably have defined our River White Gum as a variety of the same. In that case, we might have called it *filiformis* in allusion to the pedicels.

But after careful consideration we have decided to continue the River White Gum as a variety of *amygdalina*, though not without doubt. Close affinity between the type and var. *radiata* is shown by the seedling or sucker leaves; the type species approaches it sometimes in buds, mature foliage and even fruits, while we have shown the River White Gum sometimes to have rough bark. We may, perhaps, at some future time re-open the question.

3. Var. *latifolia*, nobis.3. Leaves on suckers opposite, *broad*.

Introductory.—This variety has broad, mature leaves also, as will be seen presently. We have decided to name it *latifolia* for the sake of precision. It has much in common with Howitt's var. (b) (*op. cit.*), and may prove to be so similar that it may be desirable to associate them under the same variety.

Vernacular names.—It is usually known as "Peppermint" throughout its range. It is called "Blue Peppermint" at Rylstone, "Messmate" in the Tumut, Wagga Wagga and Braidwood Districts, while we have received specimens from a small tree at Bungendore under the name of "Box Gum."

Bark.—Rough like a typical Peppermint.

Seedling or sucker leaves.—Comparatively broad; stem-clasping, more or less cordate at the base, and in some cases quite acuminate. The shape is brought out in the figure.

Mature leaves.—Broader and thicker than the preceding. An important characteristic is the strongly marked venation. On drying, the principal veins stand out in relief against the vascular tissue. Often shining, a characteristic best brought out in fully mature leaves.

The leaves of the "Blue Peppermint" (so called on account of their glaucous cast), from Mt. Vincent are not shining, neither are those from the "Messmate" or "Peppermint" from Delegate and the Snowy River. The leaves of the broad-leaved form of *E. amygdalina* from some other localities are nearly as dull in appearance. Dried specimens of leaves from the Delegate District are covered prominently with blackish dots, and the tissue of the leaf is channelled. The tips of the leaves are also sometimes hooked, all these points showing some affinity between this form and *E. stellulata* and *E. coriacea*, a subject touched upon under *Fruits*.

Up to 5 or 6 inches is a common length for the leaves, but they are barely 3 inches in some of the Bombala and Queanbeyan

specimens from ill-developed (?) trees; $4\frac{1}{2}$ inches would appear to be an average length.

Specimens up to nearly 2 inches in width are found in the Mt. Vincent specimens; $1\frac{1}{2}$ inch is a common width; $1-1\frac{1}{2}$ inch may be given as the average width.

Buds.—Operculum usually blunt, though not quite hemispherical. Sometimes glaucous, as in the Wagga Wagga and Bell's Creek specimens.

Fruits.—With a greater tendency to pear-shape than any of the preceding, and the rim to be domed or arched (Pl. lvii., figs. 4-8). Usually shining. The tips of the valves occasionally a little exerted. The rims (mouths) usually red, a characteristic often attributed to *hæmastoma*, and the fruit itself often pale-coloured.

The fruits from Bell's Creek, and from Mt. Vincent, Upper Williams River, Cobark, and other high lands to the south of New England are sometimes more truncate than usual, but the arched or domed rim can always be traced in specimens from the same tree. Fruits from Bombala and Wagga Wagga are small, and have much the shape of those of *E. eugenoides*, but they are distinctly "domed."

There is a tree ("Messmate" or "Peppermint") of which we have herbarium specimens from Delegate and the Snowy River which has shiny, comparatively thick fleshy fruits which strikingly resemble *E. coriacea* fruits in miniature. From examination of fruits alone (or even perhaps of imperfect specimens of leaves which when mature are comparatively thick), an observer might readily name the tree *E. coriacea*, and we have suggested this as an explanation of "Peppermint" being given in the "Flora Australiensis" as one of the names for *E. coriacea*. The tree now under reference has the usual fibrous bark on the stem as ordinarily observed in *E. amygdalina*.

E. amygdalina and *E. coriacea* (not to speak of other species) are closely related species, and we express the opinion that they are perhaps most obviously related through the fruits and the leaves of our variety *latifolia* of the former species.

Timber.—The description of the timber of the typical form applies very well here.

Range.—The Dividing Range and its spurs from the Victorian border north and north-west at least as far as Byng in the Orange District, and Mt. Vincent (in the Rylstone-Mudgee District), also Cobark, Upper Williams River, and other places just south of New England.

Like other forms of *amygdalina*, much observation is still required in regard to its geographical distribution.

Specific localities are as follows:—Rob Roy; Delegate and the Snowy River; Tumut; Adelong; Wagga Wagga; Bombala (Quiedong); Queanbeyan; Braidwood; Bungendore; Mt. Vincent (watershed between Capertee and Turon); Byng; high lands, Upper Williams River; Cobark (near Mount Royal Range).

REFERENCE TO PLATES.

Plate LIV.

E. coriacea.

Fig. 1.—Normal leaf.

Fig. 2.—An average leaf of var. *alpina* (Mt. Kosciusko).

Fig. 3.—Another leaf of var. *alpina* (Mt. Kosciusko).

Figs. 4, 5, 6.—Fruits of *E. coriacea*, showing variation (4, from Cooma; 5, from Southern N.S.W.; 6, from Dubbo District).

E. stellulata.

Fig. 7.—A seedling leaf (from Quiedong, near Bombala).

Fig. 8.—Leaf of var. *microphylla* (from Mt. Victoria, Blue Mountains).

Fig. 9.—Cluster of fruits (from Kanimbla Valley, Blue Mountains).

Plate LV.

E. amygdalina (typica).

Figs. 1 and 2.—Twig and cluster of fruits from New England.

Fig. 3.—Seedling leaves.

Fig. 4.—Twig, with fruits.

Nos. 3 and 4 from Hill Top, near Mittagong. The leaves are comparatively small, narrow and coriaceous.

Plate LVI.

E. amygdalina (radiata).

Fig. 1.—Seedling leaves.

Fig. 2.—Specimens of mature leaves.

Fig. 3.—Cluster of fruits.

All from Hill Top, near Mittagong.

Plate LVII.

E. amygdalina (latifolia).

Fig. 1.—Seedling leaves.

Fig. 2.—Leaf of Blue Peppermint from Mt. Vincent, Ilford, near Mudgee.

Fig. 3.—Leaf from Tumut District.

Figs. 4-8.—Fruits, showing variation in arching of rim and general contour of fruit. No. 4 from Bell's Creek, Braidwood District; No. 5 from Cobark; No. 6 from Cobark, Nos. 5 and 6 from same twig, No. 7 from Mt. Vincent (Blue Peppermint); No. 8 from Tumut District.

STRAY NOTES ON PAPUAN ETHNOLOGY.

BY C. HEDLEY, F.L.S.

I. THE CASSOWARY FIGURE HEAD.

(Plate LVIII., fig. 1.)

A distinctive feature of the carving of Eastern New Guinea is the prevalence of bird forms or their derivatives. Prof. A. C. Haddon devotes to the discussion of this subject a considerable section of his admirable essay on "The Decorative Art of British New Guinea."* Referring to the species depicted, he writes (p. 197):—"I have been unsuccessful in finding out what bird is intended; presumably it is the frigate bird, but this will not account for the frequent representation of a crest." In some instances he thought that a hornbill was recognisable, and quotes Forbes' unpublished notes that occasionally a cockatoo, and in the Louisiades a duck, was represented.

I submit that the evidence advanced below proves that the cassowary is sometimes figured, and suggests that it may be symbolised by the crested bird described by Haddon. On *a priori* grounds the cassowary, an important article of food, a source of valued bone tools, and as a dangerous quarry the theme of many a tale, would loom larger to the Papuan mind than the frigate bird. Again, if the conjoined bird and crocodile design be considered a scene, surely the last of all the fowls of the air to fall a victim to that reptile's rapacity would be the man-o'-war-hawk as sailors term the frigate bird. It is, however, within my own experience that the crane, a crested bird, may make a meal for crocodiles.

* Royal Irish Academy. Cunningham Memoirs. No. x.

In July, 1890, I was visiting the village of Polatona, in Bentley Bay, near the eastern extremity of New Guinea. Outside the travellers' house where I lodged, there was planted in the sand of the beach a post about six feet high, carved and painted in red, white and black. It so attracted my attention that I made on the spot a pencil sketch, re-drawn on Plate lviii. My enquiries elicited that it was a canoe stem or figure-head, *geroma*, and that it had once belonged to one of the Chads Bay natives, hanged for the murder of Capt. Ansell.* It had probably formed a portion of one of the large native sailing vessels, whose hulls are built of several enormous planks sewn together.

An artistically executed bird's head surmounted the pillar. My colleague Mr. North, Ornithologist to the Australian Museum, kindly examined the original drawing, and in discussing it gave me the benefit of his expert knowledge. We agree that the ball placed under the beak and the buttress behind the neck are to be regarded as decorations additional to the original scheme; that the graceful and boldly modelled neck, the general shape of the head, and especially the crest, identify the bird as a kind of cassowary; further, that the line down the neck is an allusion to the brightly coloured space bare of feathers so conspicuous on that bird.

It was not to be expected of the savage artist that his work should afford exact specific recognition of the cassowary he portrayed. The only species recorded from this locality, *Casuarus picticollis*, Sclater, differs markedly by its flattened crest, and no known species, so Mr. North says, has a beak so pronouncedly decurved. But it is possible that a bird still unknown to science was copied by the Papuan craftsman.

The bird's neck issues from the gaping and toothed jaws of the conventionalised crocodile, the angle of whose mouth is carried up in a scroll to form a large eye. In Prof. Haddon's illustrations the usual attitude of the bird seems vertical to the plane of the crocodile; here, on the contrary, it is horizontal. Below, the post

* Thomson; British New Guinea, p. 34.

was adorned by a pattern usual in that locality, white zigzag lines on a black ground divided the space into panels filled by a white scroll on a red ground, such as Haddon regards as degenerate and conjoined birds' head. Each panel may possibly typify a crocodilian scute, and certain forwardly directed loops which terminate the carving may even stand for hind limbs in a state of extreme degeneration and reduplication.

II. THE PALM LEAF CREEL.

(Plate LVIII., fig. 2.)

From its perishable nature this useful domestic utensil is unlikely to have reached a niche in the Ethnological Collection of any Museum. The only mention I have noticed of it in literature is by Lieut. Boyle T. Somerville, who, writing on the New Hebrides, observes* :—“The coconut palm leaf is very ingeniously woven in all the islands by plaiting together the long tongues of the frond, beginning at the rib and joining the tips. A mouth is made by splitting the rib down the middle, and thus a very capacious basket, with a mouth fitting as tightly as a purse, is quickly made. Pigs, yams, &c., for sale are usually carried in them.” As I have seen no published illustration of this basket, this opportunity is embraced of submitting a sketch made in July, 1890, in a native hut in the village of Mita on the north shore of Milne Bay, British New Guinea. Here they were called *Porha*, and were the exclusive property of the women, who easily manufactured them by doubling the split half of a coconut frond, threading the pinnae under and over in a darning pattern, gathering their ends together and knotting them; the rim being supplied by the split rachis. So much were these associated with women's drudgery that the men considered it quite undignified for them to touch one. A youth whom I commissioned to bring me a specimen to draw, amused me by carrying the offensive article at arm's length and flinging it down before me with an expression

* “Journal of the Anthropological Institute, xxiii., p. 378.

of disgust. A pretty scene every evening in an Eastern Papuan village is a file of women wending their way by the forest path home, each bending under a porha full of fifty or sixty pounds weight of fire-wood or garden produce. The basket is laid across her shoulders somewhat as a North British fisher lass carries her creel of fish, but instead of being slung the porha is caught by the rim in the crook of the porter's fingers.

Postscript.—Since writing the above I have been favoured by two veteran missionaries and accomplished ethnologists with the following additional information.

The Rev. Dr. W. Wyatt Gill tells me :—

“This is the common food-basket throughout the South Pacific Islands, and no doubt it is the same in the North Pacific, too. At Mangaia, it is called ‘raura’ = ‘leaflet-leaflet’ (*i.e.*, of the coconut palm). At Rarotonga it is the ‘kika’ Now, ‘kika’ is the name for the coconut leaf or frond. So although a food basket is made from only a part of a frond, it bears the same name as the whole. There are plenty of parallels to this in our own language, *i.e.*, a ‘sail’ for a ‘ship,’ &c., &c. At Aitutaki, it is called indifferently ‘taporā’ or ‘kete.’ ‘Kete’ means basket in general. Mangaia, Rarotonga and Aitutaki are the three chief islands of the Cook’s Group. I have seen exactly the same food baskets at Tahiti and each of the Leeward Islands (now French) as far back as 1852. Their name is ‘ete’ (*i.e.*, the ‘kete’ of the Cook’s Group) I believe.”

The Rev. S. Ella writes to me :—“Your drawing of it is a good sketch, only needing the knotting together of the leaflets (pinnæ) to form the bottom. It is the commonest kind of basket used, and is easily and quickly made, the material, the upper end of a coconut leaf, being always at hand. It is not so remarkable that it should be so generally used throughout Polynesia, and in almost exactly similar form and construction, when one considers its simplicity almost self-suggestive, and the general abundance of the materials; women and children make them with ease. Your description of its construction is correct. It is employed for

common purposes, carrying of taro, yams, husked coconuts, fowls, fish, &c.

“From the coconut leaf mats for placing cooked food before the eaters are formed, also blinds or enclosures to native houses, thatching for outhouses and fans. The plaiting in this case being made a little closer.

“The name of this coconut basket in Motuan (British New Guinea) is ‘bosea’; in Uvean (Loyalty Islands) ‘tang len-nu’; in Aneityumese (New Hebrides) ‘burabura,’ or with the article prefixed ‘naburabura’; in Samoan (Navigator Islands) and cognate dialects ‘atolau-niu.’

“The better class of baskets are formed from the pandanus leaf, or dressed fibre of the native hibiscus. These are more durable and carefully preserved, made in various shapes and sometimes ornamented with beads, feathers, &c. The coconut leaf basket is thrown away after it has served its purpose for the occasion.”

ON APPARENTLY UNDESCRIBED STRUCTURES IN THE LEAVES OF CERTAIN PLANTS.

BY ALEX. G. HAMILTON.

After this paper had been read it was discovered that similar structures had been described by Lundström as “Acaro-domatia.” (Pflanzenbiologische Studien. ii. Die Anpassungen der Pflanzen an Thiere). By the permission of the Council the paper has been withdrawn in order that Lundström’s important work may be taken into consideration.

NOTES AND EXHIBITS.

Mr. Steel exhibited a vivarium containing six or eight specimens of the N.S.W. *Peripatus* with their progeny, about thirty-six young, born within the past fortnight, after the mothers had been in captivity for about 10 months. The exhibitor stated that he had had the pleasure of witnessing the natural birth of numbers of these young. In the same vivarium was a young *Peripatus*, the survivor of a number born 10 months ago in captivity. Mr. Steel also showed the nodule from Macdonnell Ranges exhibited at last meeting, which had been identified by Mr. Cooksey, of the Australian Museum, as an obsidian bomb; and a little volcanic bomb from one of the small extinct volcanoes near Auckland, N.Z., where they are common, of all sizes.

Messrs. Maiden and Baker exhibited a series of botanical specimens in illustration of their papers.

Dr. Broom sent for exhibition specimens of the bone breccia from Taralga, with the lower jaws of the fossil Marsupials described by him, *in situ*.

Mr. Hamilton sent for exhibition a series of fresh leaves of a number of plants in illustration of his paper.

WEDNESDAY, MARCH 25TH, 1896.

The Twenty-Second Annual General Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 25th, 1896.

The President, Mr. Henry Deane, M.A., M. Inst. C.E., F.L.S., &c., in the Chair. The minutes of the previous Annual General Meeting were read and confirmed.

The President then read the Annual Address.

 PRESIDENT'S ADDRESS.

It was with very great diffidence that I accepted last year the honourable position which you thought fit to confer upon me. It seemed to me that the man who was selected to stand at the head of such an important Society as this should be one, who, if not actually professionally engaged in matters connected with the science of biology, had sufficient leisure to permit of his devoting a large amount of his energies to the subject.

As you are, perhaps, aware I have for some years past found my time both in and outside office hours so much engrossed in matters pertaining to my profession, that the actual scientific work that I am able to carry out is very small. You may therefore suppose that the preparation of an address of this description is to me no light task, and I am sure you will accord me some leniency, if it falls below the average of the able addresses which my predecessors in this chair have accustomed you to.

At the outset I may remind you that to-day we commemorate the Society's coming of age. On the 13th of January, 1875, in a rented room in Lloyd's Chambers, 362 George Street, the Society held its First Annual General Meeting, and on the 25th of the same month the First Monthly Meeting for the reading of papers and the transaction of scientific business. In the history of a corporation this may not be an event of such importance as it

is to the individual; still it marks the fact that infancy and childhood so to speak are safely passed, and the difficulties connected with the early growth of a Society successfully combated.

The history of the Society has quite recently been so fully dealt with in the Introduction to the Macleay Memorial Volume, that I need not go into it on the present occasion, but there are a few matters connected with the work of the Society to which I will briefly refer.

There is the increasing responsibility which, more especially in respect to financial matters, ever since Sir William Macleay's retirement from active work, has devolved upon the Council. Up to the time mentioned Sir William Macleay relieved the Council of such burdens. Nevertheless the harmony which characterised the meetings of those days continues undisturbed, and the desire of the members to cope fairly with the greater responsibilities is evidenced by the high average attendance of members at the meetings. This development in the financial aspect of the Council's work is one which should be allowed due weight in the selection of members to sit on the Council. The claims of the scientific aims of the Society to be represented are not in danger, as we have many active members ready to look after its interests in this respect. The endowment fund, lately increased by the addition of the Bacteriology Bequest, amounts to over £30,000. To invest wisely and to keep wisely invested so large a sum, the duty of which devolves on the Council, requires the selection of a fair proportion of members skilled and experienced in financial matters.

The Proceedings of the first two years of the Society's work were issued as Volume I. In the course of the next few weeks the publication of our twentieth volume will be completed. While a high average of value has been maintained we have, in amount of matter published annually, outstripped most of our sister Societies in Australasia, and our ability to do this we owe to the beneficence of Sir William Macleay.

In his address last year my predecessor, Professor David, furnished full particulars of what, it was supposed, was the final settlement—so far at least as this Society was concerned—of matters relating to the late Sir William Macleay's bequest for the endowment of a lectureship in Bacteriology. It was with some surprise, therefore, that in July last the Council received from the Senate of the Sydney University an intimation of its intention to relinquish the bequest, and to return the money to the executors. This was subsequently done, and the money paid by the executors into Court. On October 15th, 1895, on the petition of the Society, the Chief Judge in Equity made an order for the payment to the Society of the sum in question, less costs, namely, £12,704. This amount represents Sir William's original bequest of £12,000, less legacy duty and law costs, plus interest accruing on fixed deposit from the time of the receipt of the money by the University until that of its repayment to the executors.

It devolves upon the Council, as the managers of the Society's affairs to provide for the investment and to keep invested the money to the best advantage; and out of the income to pay a competent Bacteriologist, and provide and maintain a suitable laboratory and appliances.

The clause of the Memorandum attached to Sir William Macleay's will is as follows:—"Should the Senate decline all or any of these conditions I empower my executors to hand over the aforesaid sum of twelve thousand pounds to the Linnean Society of New South Wales to provide a sufficient salary by the year to a competent Bacteriologist who shall be called the Bacteriologist to the Linnean Society and whose duties shall be to conduct original research in the Laboratory of the Society and to give instruction to one or two pupils at the discretion and under the orders and control of the Council of the Society any surplus to be applied to laboratory requirements."

Thus it will be seen that the Council is left with discretionary powers in fixing both the amount of the Bacteriologist's salary, and the date of his appointment. In determining the first of these points, the Council has had to be guided by the

amount of the annual income which the principal may be expected to yield. Now this, in consequence of the serious depreciation in value of all sound income-producing investments which has become so marked a feature in our commercial life since Sir William made his will (in December, 1890), is, I regret to say, likely to be for some years to come a sum considerably smaller in amount than Sir William contemplated would be available for the purpose.

Then as regards the date of the appointment. Since without a suitably equipped laboratory the Bacteriologist cannot carry on the work he is specially to be appointed to do, it is evident that the arrangements for providing the former must progress something like *pari passu* with any scheme for filling the post of Bacteriologist. Before any research can be entered upon, provision must therefore be made for an initial expenditure of something like £700 for equipment and incidental preliminary expenses—or more than one year's income. The necessity for proceeding slowly and with caution led to the Council's appointing a sub-committee to consider generally and report on the best way to give effect to Sir William Macleay's wishes. On presentation of this report it was carefully considered by the Council, and with some slight modifications it was adopted. The result is that the Council has decided that, provided a suitable investment can be met with at a rate of interest not lower than the then current rates, the appointment might be made so as to take effect at the close of the hot season of 1896-97, provided also that a competent Bacteriologist can be engaged on what are practically the terms and emoluments offered to University Demonstrators.

Besides a further postponement of say one year, two, or even three years should circumstances seem to demand it, there is yet another alternative, namely, to make an indefinite postponement with a view to a very substantial accumulation of interest to be added to principal. Against this course it may be urged that on general grounds it is desirable that as soon as circumstances permit the appointment of a Bacteriologist should be proceeded with;

and that already nearly four years have elapsed since the principal became available. And while on the one hand the Council does not expect to attract an eminent European Bacteriologist to the Colonies—nor could Sir William have contemplated such a contingency; yet on the other hand the Council is not altogether without hope that it is possible to find a thoroughly competent and enthusiastic Bacteriologist, animated with the true scientific spirit, who will appreciate the prospect of carrying on original investigations under very favourable circumstances.

With satisfaction may be noted the pleasing evolutionary development in the scope of the Society's scientific work. At the outset this was exclusively zoological. In the Second Annual Address of the first President (Sir William Macleay) the hope was expressed that at no distant date contributions from botanists and geologists would find a place in the Proceedings. Sir William lived to see that hope amply fulfilled. Animal morphology also has become an important feature of the Proceedings. One would be glad to see the morphology of plants commanding a portion of the attention it deserves, but the outlook is not a promising one in that direction anywhere in Australia. The subject apart from that of Bacteriology, languishes at present for want of students for the conditions for their encouragement here are wanting. It would be well if we had even a small edition of such a botanical laboratory as that at the Botanical Gardens at Buitenzorg, Java, so ably presided over by Dr. Treub, and so liberally provided for by the Dutch Government.

Since the last Annual Meeting our numbers have been diminished by the deaths of one Honorary and three Ordinary Members. Professor Sven Lovén, the eminent Swedish naturalist, died on September 6th last at the advanced age of 87. Since 1841 he had filled the appointments of Professor and Conservator of the Royal Museum of Natural History, Stockholm. He devoted much study to the marine fauna of the Baltic and the North Seas, special attention being given to Echinoderms. Professor Lovén was elected an Honorary Member of this Society in 1891.

Of the Ordinary Members, two—Dr. Paul Howard MacGillivray and Mr. J. Bracebridge Wilson—were resident in Victoria. They have strong claims to be held in grateful remembrance by Australian naturalists. Dr. MacGillivray belonged to a family of naturalists. His father was Professor of Natural History at King's College, Aberdeen, and his brother, the late John MacGillivray, was author of the "Voyage of the Rattlesnake." Since 1857 Dr. MacGillivray had followed the practice of his profession in Victoria, at the same time showing himself a public-spirited citizen much interested in the spread of knowledge and culture. Much of his leisure for many years was devoted to the study of Australian Polyzoa, and he was the author of an important series of papers thereon, contributed to the Proceedings and Transactions of the Royal Society of Victoria, or to Professor McCoy's Decades. These date from the year 1859. His important "Monograph on the Tertiary Polyzoa of Victoria" was passing through the press at the time of his death, and has since been published.

Mr. J. Bracebridge Wilson, M.A., F.L.S., who died on October 22, aged 67, was for many years Head Master of the Church of England Grammar School, Geelong. Like Dr. MacGillivray, he was a busy professional man, whose leisure was given up to Natural Science, out of pure love for it. In utilising his yacht in dredging and trawling he found his hobby. This was done in a scientific systematic way, with the object of accumulating stores of well-preserved material for the elucidation of the marine fauna of Port Phillip by specialists, he himself sharing in this part of the work as far as opportunity served.

Nearer home we have lost, at the early age of 30, one of the younger school of naturalists—Arthur Sidney Olliff, who died December 29th last. Mr. Olliff came to New South Wales in February, 1885, to take up the work of Assistant Zoologist, in the Division of Entomology, at the Australian Museum, where he remained until his appointment as Entomologist to the Department of Agriculture, Sydney in 1890. He had been for some time in enfeebled health, and shortly before his

death he had in contemplation a visit to England in the hope of benefiting by the change. Many of his papers on Lepidoptera and Coleoptera will be found in our Proceedings. An appreciative notice by one of his colleagues, together with a complete list of Mr. Olliff's papers, has appeared in the *Agricultural Gazette*, Vol. vii. Part 1 (Jan. 1896).

The year 1895 is especially memorable by the deaths of Huxley and Pasteur, two of the foremost leaders in Science. They occupied so prominent a position in the scientific world that their loss has been truly felt to be of world-wide importance. In the *Journals and Magazines* of the countries on both sides of the Atlantic have been published numerous well-merited eulogies of their lives and work, written from very varied standpoints, and in many cases based upon special or personal knowledge. As they are within reach, and have probably already come under your notice, I should be at a disadvantage in any attempt to touch further upon themes which have already evoked sympathetic and appreciative treatment from those best qualified to speak.

I propose now to say a few words on the subject of Forestry—the importance of which is much underrated.

Our forests have been left hitherto very much to themselves, the idea being that as Nature has looked after them in the past so a kind providence will continue to do so in the future. The fact is overlooked, however, that with new conditions of settlement the chances of shapely young trees growing up to replace those removed are reduced to a minimum; and so, as has occurred in other countries, the depletion will go on till sooner or later a feeling of alarm arises and the necessity for commencing the work of afforestation is recognised, and the task has to be undertaken at a much greater cost than if time had not been lost.

The ignorance of the benefits to be derived from proper management of the forests is very remarkable. We are possessed of timber which in strength and durability can vie with the products of all the world, and a large revenue could be made out of it. Forestry is, as has been happily said by Professor Bailey Balfour,

a division of rural economy which ought to be the basis of a large national industry.

It is under this aspect that we have chiefly to consider it, and though we may look upon the conservation of our forests with respect to their influence upon health and climate, and upon the soil itself, we are perhaps still more interested in them as a possible source of direct commercial profit on account of the valuable material they furnish.

On the other hand we must not forget that they confer an indirect benefit by protecting the soil and altering the conditions of temperature.

Much lasting injury is done to forests by allowing the pasturing of sheep and cattle in them. Young seedlings which should take the place of those cut down are trampled, browsed down or otherwise so bruised and injured as to be worthless.

Firing of the undergrowth is an evil which is much misunderstood. It is often done by settlers to promote the growth of grass; the fire spreads outside the limits of their land, and much devastation follows. The immediate effect is not only to destroy the promising young growth, but also to char the humus and spoil the fertility of the soil.

It will be well to consider shortly the climatic and hygienic influence of forests. For those who wish to investigate the matter in some detail, I would recommend the perusal of a pamphlet published by the Forestry Division of the United States Department of Agriculture in 1893, entitled "Forest Influences." We have here a series of reports on the different branches of the subject, and there is an able summary of the whole case by Mr. B. E. Fernow, Director of Forestry. As the results are undoubtedly applicable to a considerable portion of this colony, I will refer to them in some detail.

Two classes of effects are to be noticed—namely, those on the general climate and those on the local climate. When we build a house we alter the temperature and humidity conditions of the space covered, and so it is with forest cover, but the question

arises can we alter the conditions on a larger scale by alternating forest and field, or by preserving intact large areas of forest?

In reply to this query, it seems to have been shown by the forest planting at Lintzel that a considerable change in the meteorological conditions resulted.

Forest cover causes obstruction to the winds and hinders the action of the sun's rays upon the soil. A difference in temperature and evaporation outside and inside the forest area then arises. When the areas of the different kinds are large enough, local currents of air will be set up, which will cause the interchange of conditions between the two areas. The size and character of the forest growth, density, height, situation and composition are the factors which determine its influence. It is not trees but masses of foliage that do the work.

On water supply the effect of forest is undoubted. The soil acts as a sponge from which the water runs off gradually; remove the forest wholesale, and the water rushes along, tearing away soil and flooding and injuring growing crops.

Irrigation is generally advocated for arid regions alone, but it is also particularly serviceable in well watered regions, and here, as above shown, forest cover materially assists.

The following observations are of interest:—

First, as to the difference of conditions within and without the forest. On the average the forest is cooler than the open country in summer, but about the same in winter, with a warming effect in spring, and the evaporation is only one-half that in the open.

The percentage of rainfall evaporated is about 40% in the open and about 12% in the forest, taking the whole year.

The total quantity of moisture returned into the atmosphere from a forest by transpiration and evaporation from the trees and the soil is about 75% of the precipitation; other forms of vegetation give from 70 to 90%; bare soil gives only 30%. Gauges in European forests catch 75 to 85% of the rainfall, the rest runs down the trees, is intercepted or evaporated.

The experience of increased rainfall over the station at Lintzel with increase of forest area points strongly towards interdependence.

Secondly, as to the influence of forests upon the climate of the surrounding country.

Any effects that arise must either take place by diffusion or by means of local air currents, or from the fact of the forest acting as a windbreak.

Deforestation allows of the uninterrupted sweep of winds over the country, the evaporating and parching effects being much more intense than those resulting from mere dryness of the air. This class of effect is, of course, worse in flat country and on the seashore.

When moisture-laden winds pass over cool areas of forest the possibility of condensation is at least not reduced, whereas heated plains certainly do reduce it. The presence of large forests in Asiatic and European Russia has been shown to produce a sensible effect in lowering temperature.

In general we may expect that an alternation of large forested and unforested areas in regions which on account of their geographical situation have a dry and rigorous climate is more beneficial than large uninterrupted forest areas which would fail to set up that local circulation which is brought about by difference of temperature and permits an exchange of the forest climate to the neighbourhood.

The results of systematic observations in forest meteorology made in France, Germany, Sweden, Austria and elsewhere, and extensive observations on temperature and rainfall extending to Russia and India are given in the Report.

It seems scarcely necessary to mention the sanitary effect of forests. As is well known, trees have been planted with success to absorb the moisture of swamps, and the exhalations of eucalypt trees are particularly beneficial in counteracting malaria.

The idea that our forests may get exhausted is often jeered at, and figures have been brought forward to show what an enormous and practically inexhaustible supply of timber exists; yet in other

countries with still larger supplies a panic has arisen. The more rapid depletion of our forests for purposes of export is constantly being urged as if we had there, without any trouble on our part, an unfailing source of revenue. By all means let us export, but let us first take steps to replace what is taken away and insure the future.

Some months ago, as the result of a communication which I addressed to the Minister for Works protesting against the exportation of ironbark, a return was prepared by the Forest Branch purporting to show that the forests of this colony would supply over $167\frac{1}{2}$ millions of sleepers, which sounds like an enormous quantity. An examination of the return shows that two-thirds of this quantity is to be obtained from the forest reserves in the Casino and Glen Innes districts, that of the former being reported to cover about 4000 square miles and the other 2000 square miles. Those estimates seem large, and it is curious to note that when the Glen Innes-Tenterfield railway was being constructed the prices paid for stringy bark sleepers was 6s. 6d., while 7s. each was paid for ironbark. This does not look like an abundant supply. It is one thing to have trees scattered through a forest, and another to get them out at reasonable cost.

Assume, however, for the moment that the above quantity of sleepers is obtainable, and that instead of many of them being locked up in almost impenetrable gullies they are obtainable at a small cost, what is likely to be the future demand? Our own requirements for sleepers are at the rate of 2400 per mile, and 1000 miles would only require about 2,400,000 sleepers, but all Australians must hope that with the development of the country, many thousand miles of new lines will be required, and then we have to provide for renewals. Now suppose in addition to our own requirements we foster trade with other countries. In the United States of America there are 180,000 miles of railway. They put their sleepers much closer together than we do, so that they require 3000 to the mile at least. The timber used at present is pine or white oak, the best of which only lasts ten or twelve years. What, if our American friends were really to take

a fancy to ironbark, could we supply their wants? The number required to fit up all the lines would be—say, 540 millions, so that we should only have a third of that quantity, neglecting our own requirements. England and Europe, too, possess an enormous mileage, and might come upon us for supplies; but, as is seen, we simply could not meet them. Then what right have we to talk about encouraging a large export trade until we take steps to increase the natural productiveness of our forests?

In another State Report of the United States Department of Agriculture—namely, that on the “Forest Conditions of the Rocky Mountains, 1889”—there is a paper by Dr. E. J. Janus, which is remarkable as bearing upon the question of the value of forest culture which is so much neglected or ignored. It is scarcely necessary to remark that the Rocky Mountains are the home of some of the principal mining industries in the United States, and are in the centre of an arid region which, except for the streams arising from the melting of the snow on the heights, has little water to depend upon. Therefore, Dr. Janus’ observations, which are made with special reference to this region, are particularly worth attention:—

“The forests of any large country bear a peculiar relation to material prosperity. They not only constitute a large proportion of the national wealth of a nation, but they form the independent basis of a flourishing agricultural, manufacturing and commercial industry. They are, moreover, one of the most important elements in determining the climatic condition of any given region, and through these the distribution of population, of industrial pursuits and of disease and health.” He goes on to say that “the value of the forests is greater than all the metals, coal, petroleum, stone, and all the steamboats, vessels, &c., plying in American waters and belonging to citizens of the United States.” He complains that practically nothing is done to protect or to cultivate, a statement which equally applies to this country, and yet three-quarters of the population use wood as a fuel. In the Australian bush there is at present an apparently unlimited supply of fuel, yet the scarcity of it in the neighbourhood of the larger towns

and centres of industry like Cobar and other mining districts is already painfully felt.

There is an impression that forestry does not pay. There is certainly no greater mistake. The experiences of other countries prove it. I find that in 1884 in Baden the area of the State forests was 234,000 acres, producing a net return of £120,000 annually; in Württemberg the area was 476,000 acres, and the profit derived was £237,400; while in Saxony, with a forest area of 408,000 acres, the net return was as high as £330,000. Perhaps some might argue that although forests would pay in Europe, under the different conditions prevailing here they would not; but a little consideration will show that the conclusion is not warranted. If our hardwood trees grow more slowly—which is, however, not the case, at least on the coast—the produce is of higher value; and in the interior, where from lack of moisture they do grow slowly, the rental value of land is much lower. It can, I think, be easily shown that forest cultivation on areas which do not furnish abundant grass or herbage would produce at least five times as much income from timber as from grazing. Of course the Government would have to keep control of the timber, and not merely for a small fee give a man a license to destroy or cart away as much as he likes.

Professor Bailey Balfour, in his Address to the Biological Section of the British Association in 1894, gives an interesting example of a piece of ground at Nover in Rossshire, which was worth from one to two shillings grazing rent. This land was planted with trees, and after 61 years of growth was clean cut in 1883. The net yield of the land over this period was equal to an annual revenue of nine shillings per acre per annum.

There are cases given in the United States Reports of worn-out sandy land being planted with trees and yielding a profit of twelve shillings and sixpence per acre per annum when cut for fencing posts.

Forest conservation means not that no trees shall be cut down, but that the forests shall be cultivated as any other crop, and not wasted. Steps should be taken to prevent the spread of fire

and the browsing of animals of all sorts on growing forests. This is of the utmost importance.

The matter is one generally for the State to take up, yet there are immense tracts under private control which would pay better as forest than as grazing land, and if proper instructions could be given, suitable schools of forestry instituted, men could be trained both for the employment of the State and to assist private owners. Land owners would be taught to see that it is in the interests of their property to plant and conserve, for the existence of young plantations even, which only their followers will reap the full benefit of, will mark the growth of, to them, an important asset.

In many parts of Europe the organisation for the control of the forests is most excellent. Perhaps of all countries Switzerland is the most advanced. The Reports of United States Consuls, 1887, give some most valuable and interesting information under this head.

Forestry is not only a matter of vital interest as to poor lands, but the reclamation of waste lands can be made profitable. I find it mentioned in another United States Report that in 1885 there were 10,000 acres of thriving forest on Cape Cod planted 30 years before on sterile sands, and extensive woodlands similarly planted at Wood's Hill ; on the other hand, other places that have been denuded have become barren.

On the shores of the Bay of Biscay dunes once stretched over a hundred miles in extent. Sands were driven up the slopes, forming dunes from 100 to 300 feet above the limit of the sea, and moving inland they carried great desolation. Bremontier, a century ago, persuaded the French Government to allow him to experiment, and now there are over 100,000 acres planted with maritime pine, blocking the sea out. The land at the back which was formerly useless is now cultivated, and not only are the hygienic results most remarkable, but the French Government derives a revenue of 180,000 francs from the timber.

In connection with this subject I have endeavoured to obtain some data as to the rate of growth of trees, and the period at which maturity is reached in Australia as compared with Europe. In Europe numerous observations have been made which are given in the above-mentioned Consular Reports. It is stated that trees are allowed to grow as follows :—

Red beech	...	...	...	...	120 years
Oak	...	...	...	...	160 „
Elm, ash and maple	...	...	...	...	80 „
Birches and alders	...	...	...	...	60 „
Other species	..	...	...	...	40 „
White fir	...	...	...	...	100 „
Pine and fir	...	...	...	...	80 „
Larch	...	...	...	...	60 „

Growth in height and girth is most rapid up to 40 or 50 years, after which the rate declines. The increase in bulk, however, proceeds at an increasing rate, as might be expected, seeing that the roots are constantly spreading.

It is much to be wished that systematic observations on the growth of trees, native and exotic, should be made in Australia; but it would appear from the information obtainable that it is, under fairly favourable circumstances, at least equal to that in Europe.

The late Rev. J. E. Tenison-Woods* thought “that the tallest trees of the forest, the giant timber of Tasmania, range from fifty to seventy-five years old.”

The late Rev. Dr. Woolls† says “whatever may be the ages of the Tasmanian Eucalypts, I believe that the harder woods in the County of Cumberland are slow in growth, and that centuries elapse before they reach their full proportions.”

* “Tasmanian Forests.” Journ. and Proc. Roy. Soc. N.S.W. 1878. xii. p. 22.

† Proc. Linn. Soc. N.S.W. 1880. v. pp. 508-509. See also the same author's “Contribution to the Flora of Australia” (1867), pp. 220-221; and “Lectures on the Vegetable Kingdom” (1879), p. 93.

This does not quite agree with my own observations.

Both in the "Eucalyptographia" and in the "Select Extra-Tropical Plants" (Ninth Edition, 1895), Baron von Mueller has supplemented his own experiences with a considerable amount of information from other sources. The Baron considers that *E. globulus* "is, among evergreen trees, of unparalleled rapid growth." And of *E. amygdalina* he says that "plants grown on rather barren ground near Melbourne have shown nearly the same amazing rapidity of growth as those of *E. globulus*." The following instances relating to extra-Australian localities are selected from a large number quoted by the Baron:—In eight years in the south of France *E. amygdalina* attained a height of 50 feet. *E. globulus* in Jamaica attained a height of 60 feet in seven years; in California 60 feet in eleven years; in Florida 40 feet in four years (stem-diameter 1 foot); in the Neilgherry Hills 30 feet in four years (one tree, twelve years old, being 100 feet high, and 6 feet in girth, at 3 feet from the ground). Near Pretoria the same species "attained a stem-circumference of $9\frac{1}{2}$ feet in 22 years"; and "in Algeria and Portugal it has furnished railway sleepers in eight years, and telegraph-poles in ten years."

Mr. H. C. Russell, F.R.S., the Government Astronomer, supplied some particulars in some notes read before the Royal Society of N.S. Wales in 1891, and these he has kindly supplemented with later information.

The trees measured were Eucalypts, growing at Mt. Victoria, and Lake George, and others planted in Observatory Park.

At Lake George one of four young trees was selected for measurement in January, 1885, when its girth three feet from the ground was found to be 23 inches. On 10th November, 1891, its girth was $52\frac{1}{4}$ inches; on 22nd November, 1892, it was $54\frac{1}{4}$ inches; on 1st January, 1894, $60\frac{1}{4}$ inches; and in January, 1895, $63\frac{1}{4}$ inches.

Other trees have been marked since the notes above-mentioned were made, and the results will be watched with interest. At Mt. Victoria on barren ground, about fifty years after Sir T. Mitchell had cleared one of the hills for survey purposes, the trees

were found to have grown up again, attaining a diameter of 15-20 inches; after fifty years' growth the girth was about 63 inches. In Observatory Park specimens of *Eucalyptus globulus* grew to 41½-46 inches in circumference in 16 years. Some examples of *Pinus insignis* of the same age were measured in November, 1891, and were found to be from 31½ to 35½ inches in circumference 3 feet from the ground. The situation, however, Mr. Russell says, does not suit this species of tree, so that of course under favourable circumstances the growth would have been much greater.

I have obtained from Mr. Bray, Police Magistrate of Murwillumbah, who has had long and valuable experience in the "bush," some particulars as to the growth of red cedar, *Cedrela australis*, and other trees. He says, writing to Mr. Caswell:—"I have seen a cedar sapling about one foot in diameter and, I should say, 3 or 4 years old, grow into a tree 3 feet in diameter (20 feet from the ground) in 17 years." "It is very hard to tell when a tree has matured, but from what I have seen of different trees, I should say that most of the 'scrub' trees would grow into good timber and to full size in 25 years." As to the number growing per acre, he adds, "I once felled 38 cedar trees on one acre of land; all these were large trees, none less than 3 feet in diameter, 20 feet from the ground. This was up near Tyalgum." "Some of the very large cedar trees that I have seen here must have been very old—perhaps 100 years."

Mr. Gill, Conservator of Forests at Adelaide, found poplar, pine and oak grown at the Botanic Gardens, Adelaide, to be of good convertible size after 30 years. At Mount Gambier *Pinus insignis*, after 30 years, fetched fifty shillings. Mr. Gill is of opinion that whereas trees in Europe take 60 to 120 years to mature, they will take only half that time in Australia. Specimens of *Eucalyptus globulus*, after 17 and 18 years, produced telegraph poles 25 feet long, each from 8 to 10 cubic feet in measurement. The trees were from 50 to 60 feet high. *E. corynocalyx* (sugar gum) grew after 14 years to a height of 68 feet—a bottom log 12 feet long, containing 11 cubic feet, was cut

out. The timber of this species is now accepted as teredo-resisting, and is being largely planted under Mr. Gill's directions. Mr. Gill says :—"To give you some little idea as to size of timber grown within 20 years, I may state that poles lately cut by me for telegraph purposes, and disposed of to the Telegraph Department, measured 26 feet 6 inches long, and were 7 in. to 8 in. top diameter, and 11 in. to 14 in. bottom diameter. They contained from 8 and 9 to 17 and 18 cubic feet of timber, and this is irrespective of other parts of the tree, which generally totalled from 60 to 70 (or even over) feet in length."

It is apparent from the above that where the climate is favourable the growth of trees is quite sufficiently rapid to justify large expectation of profit. In the interior growth is necessarily much slower, but must still be noticeable. The comparative rate of growth, as compared with trees on the coast, may be assumed to be roughly proportioned to the moisture of the ground, all other things being equal; and it is, therefore, probable that an ironbark in the climate of Dubbo (250 miles from the coast) will take twice as long to grow as the same species where the rainfall is twice as great. Of course this is only surmise, and accurate observations are required.

It is, however, perfectly clear that if on the forest land of the eastern slopes of the main range, where such land might be worth one shilling per acre for grazing purposes, it will pay to grow timber; then in the interior, near the railways, the poor ridges, which are not worth one penny per acre, would if put under cultivation for trees yield a very handsome profit indeed; but it must be understood that this expectation can only be realised if care is taken in growing the trees. They must be started in nurseries, planted out, and, until they have grown to a considerable size, must be properly fenced off and protected from the browsing and ravages of animals and man. Strict measures must also be taken to preserve them from injury or destruction by bush fires.

It is certain that if proper measures were taken a profitable industry could be carried on, giving employment to large numbers

of men. I find that some years ago in Switzerland, where, as above stated, the State management yields a large revenue, there were employed on the forests 5,851 persons, including 150 trained forestry officials and from 1,500 to 2,000 foresters and overseers, the area of forest being 1,940,659 acres.

It is impossible to exaggerate the importance of this subject, and it is to be hoped that with the assistance of the able officers which the Government have at their service some really energetic steps may be taken.

I gather from reports kindly furnished to me from Mr. Gill that in South Australia the area inclosed for planting operations was, on the 30th June, 1894, 11,425 acres, and that during the year following that date an additional area of 320 acres was added. This is a good start for a colony where indigenous timber of value is scarce, and I sincerely wish success to Mr. Gill's efforts.

In order to prove what a hold this question has already obtained upon the practical commercial mind in America, I quote the following from the Century Magazine of September last:—

“During the present year the advocates of a modern forest policy have received the important support of the two leading mercantile organisations of New York City. On January 3rd, 1895, the New York Chamber of Commerce, after special consideration of the subject, adopted unanimously the following resolutions:—

Whereas, A thorough inquiry into the question of the preservation of our forest lands is of permanent importance to agricultural and other interests, thereupon be it

Resolved, That this Chamber recommend to the United States Senate and House of Representatives in Congress assembled, to pass a Bill which authorises the President of the United States to appoint a Commission of three experts and make the necessary appropriation for the purpose or a thorough study of our public timber lands, so as to determine what portions ought to be preserved in the interest of the people, to prepare a plan for their management, and report the same within a year of their appointment. The Commission to have access to all public documents bearing on the subject.

On June 12th, 1895, a similar meeting was held by the New York Board of Trade and Transportation, and after discussion of the larger aspects of the subject the following resolutions were unanimously adopted :—

Whereas, The welfare and the commercial interests of the entire country are closely related to the preservation and proper management of the public forests.

Resolved, That as a first step to a permanent and scientific forest policy, we heartily favour the creation by Congress of a National Forest Commission with the following objects :—

1. To study the public timber lands, reserves and parks, on the ground.
2. To ascertain their condition and extent.
3. To ascertain their relation to the public welfare and to existing local needs of the people as regards agricultural and the supply of wood for mining, transportation and other purposes.
4. To ascertain what portions of the public timber lands should remain as such in view of the agricultural, mining, lumbering and other interests of the people.
5. To prepare a plan for the general management of the public timber lands in accordance with the principles of forestry.
6. To recommend the necessary legislation ; and

Resolved, That the Special Committee on Forestry be directed to communicate with other commercial bodies and with Congress in furtherance of concerted action on this important question at the next session."

The study of the fossil remains of plant life of past ages in this country has of late years received some attention. Professor Ettingshausen, of Graz, has had the lion's share in this work, and as he has expressed views as to the origin of the vegetation of Australia, and of the rest of the world, which appear to be entirely erroneous, and as they appear to be tacitly accepted by Professor Tate in his Inaugural Address to the Adelaide meeting of the Australasian Association for the Advancement of Science, I desire to say some words on the subject, in the hope that some of our New South Wales Botanists and Palæontologists may take the matter up and corroborate or disprove the deductions which, in my opinion, can be made.

Generally speaking, Professor Ettingshausen's theories amount to this, that in Tertiary times, or earlier, there was a universal flora of mixed types, which later on, through the influence of floral climates, became sorted out, so that at the present day distinct regions present distinct peculiarities which at first did not exist.

That the Australian region has now a flora of its own more marked and peculiar than perhaps that of any other region of the earth's surface will be disputed by none. At first sight this circumstance seems to have a parallel in the existence of types of land mammals, stragglers only of which are to be found elsewhere, and this view is apparently strengthened by the fact that in past ages monotremata and marsupials lived in Europe, while, according to Unger, Heer, Ettingshausen, and a few others, Australian types of plants, Eucalypts, Proteaceæ, Casuarineæ, and many others also flourished.

The subject is one well worth careful investigation.

The monotremata we know first made their appearance in the Northern Hemisphere in the Triassic Age, and marsupials of low type are first found in the beds of the Oolitic (Jurassic) Series. In the rest of the Mesozoic series no animals of higher development than marsupials have been discovered, but no sooner do we reach the Eocene than it is evident that an enormous advance has been made, for we find ourselves surrounded with animals of much higher type, including the reputed ancestors of the horse, deer, antelope, squirrel, hedgehog, bear and others. Many remarkable animals existed also of types that have long died out. Searching upwards through the Oligocene, Miocene, and Pliocene, and continuing into the Pleistocene we find, as the meaning of those names implies, more and more resemblance to the animals now living outside the Australian region, while at the same time we still keep sight of a few marsupials having affinities to the American opossum. This progression of types is utterly wanting so far as has been discovered in Australian strata, and it is only in the Pliocene beds that we first come upon undoubted proof of the existence of



mammals, and then we find all at once an abundance of highly differentiated marsupials with monotremes whose descendants comparatively little changed in type we have around us at the present day. That these highly differentiated Australian types had no representation, so far as is known, outside Australia, except in the extreme south of the American continent, is a fact full of significance.

It would appear then as if at the end of the Mesozoic period before the evolution of the higher orders of mammals took place there must have existed a territory already inhabited by marsupials, which then became cut off from the rest of the land to the north, and that in this land—a portion of the pre-existing Gondwana Land of Suess, or Antarctica of Forbes—the differentiation of the marsupials occurred, and that further this land, which may have been shifting in character, was at the end of the Miocene or beginning of the Pliocene, connected with Tasmania. Mr. C. Hedley's paper on the "Surviving Refugees of Antarctic Lands," read before the Royal Society of New South Wales last year, deserves thoughtful consideration.

I have devoted some space to the above matter because it bears on the question of the origin of Australian Vegetation. It is clear that the peculiar Australian types could not have been immigrants by the same route as the marsupials, or, indeed, immigrants at all, but the above considerations show the great probability of the existence of extensive land surfaces in the Antarctic regions at the end of the Mesozoic and in the earlier Tertiary times; that the connection with more northern lands was of a somewhat fleeting character, and that while it permitted of the passage of one element of the Australia Flora from South America to Tasmania, the succession of these fluctuating land surfaces did not allow of any large migration of Australian types in the opposite direction.

In his "Introduction to the Flora of Tasmania," published in 1860, Hooker sets forth the facts connected with the distribution of plant life in Australia and Antarctic lands. This able work is still the best complete treatise on the subject, and only requires

to be brought up to date by utilising the results of the investigations of Baron F. von Mueller and others to make it of full value at the present day.

Hooker points out that what appears to be the indigenous vegetation, and which is, taking the whole continent together, by far the most important both in numbers and characteristics, has been added to in different ways. The coast strip of the north and east has been subject to an invasion of Indian and Malayan forms. These are quite distinct in character from the true Australian ones, which seem to have had their centre of distribution in the south-west portion of the continent.

Mixed up with the flora of the eastern part of Australia, and especially in the south, is a group of plants from the northern temperate regions, which seem to have forced their march upon Antarctic lands by following down the Andes chain to the extreme point of South America, leaving traces on the way, and thence stepping across by land links, which once existed but have now disappeared, the gaps between that continent and New Zealand and Tasmania. This element of the flora is most largely represented in New Zealand and Tasmania, but has also pushed its way up Eastern Australia, particularly affecting the higher mountain tops as they proceed northward, and we even find representatives on mountains of great elevation in New Guinea, and Borneo*

It is remarkable that among the plants thus introduced into Australia there are 17 European species, most of which occur in Britain.

It is almost needless to remark that the typical Australian types are with few exceptions absent from New Zealand.

Hooker further draws attention to the remarkable similarity in character existing between the vegetation of South Africa and

* Trans. Roy. Soc. Vic. Vol. II. Mueller, "Plants of Owen Stanley Range in British New Guinea."

Trans. Linn. Soc. Botany, Vol. II. Part 2. Dr. Stapf, "Flora of Mt. Kinabalu in North Borneo."

Australia. The principal natural orders and groups, which by their abundance produce this result, are the following :—

Proteaceæ, *Compositæ*, *Iridæ*, *Hæmodoreæ*, *Polygaleæ*, *Restiaceæ*, *Ericaceæ* (corresponding in South Africa to *Epacrideæ* in Australia), *Papilionaceæ*, *Rutaceæ*, *Thymeleæ*, *Santulaceæ*, and some others.

This looks like parallelism of development from a common origin.

Below is a list of the more important groups, natural orders, tribes, genera or parts of genera, as the case may be, which serve to make up the peculiar and predominant element of the Australian Flora. The orders *Proteaceæ*, *Ficoideæ* and *Restiaceæ* are markedly South African as well. Outside the Australian region and South Africa some scattered representatives of the groups mentioned are to be found. These have the character of escapees; compared with the allied Australian species, their number is insignificant, and one cannot avoid the conclusion that Australia, or some southern land of which Australia is a remnant, was the origin and home of the various races. It is true that some of the outside representatives of Australian types are now separated by wide gaps of ocean from their congeners, but Wallace, in his "Island Life," has shown how plants can thus cross serious obstacles without the existence of actual land connexion. Some of the wanderers are dwellers near the seashore, and thus always ready, as it were, when the means presents itself, for transport by sea. Some have travelled in the reverse direction to the Indian and Malayan immigrants, while others have reversed the order of march of the European invaders already referred to, and have passed up the Andes.

TYPICAL AUSTRALIAN GROUPS.

DILLENIACEÆ.—Tribe *Hibbertiæ*.

PITTOSPOREÆ.—All genera except *Pittosporum*.

TREMANDREÆ.

RUTACEÆ.—Tribes *Boronieæ* and *Zanthoxyloæ*.

STACKHOUSIÆ.

LEGUMINOSÆ.—Tribe *Podalyriæ*, &c. Phyllodineous section of genus *Acacia*.

HALORAGÆ.—Genus *Haloragis*.

MYRTACEÆ.—Capsular Group.

FICOIDEÆ.—Genus *Mesembryanthemum* and *Aizoon*.

STYLIDIÆ.

GOODENOVIEÆ.

EPACRIDEÆ.

MYOPORINEÆ.

LABIATÆ.—Tribe *Prostanthereæ*.

PROTEACEÆ.

THYMELEÆ.

CASUARINEÆ.

ORCHIDEÆ.

JUNCACEÆ.—Tribes *Xeroteæ* and *Xanthorrhææ*.

RESTIACEÆ.

Wallace in his "Island Life," the first edition of which appeared in 1880, gives his views as to the point of origin of the Australian types. He places this in the south-west of Australia and assumes the possibility of extension of the land outside its present limits. The western half of Australia was cut off, he says, from the eastern half by the Lower Cretaceous Sea which ran right through the centre of what is now Australia, from north to south. He accounts for the existence of Eastern Australian forms of the typical vegetation by the assumption that they crossed this barrier in the same way as it is known that plants in course of time find means of leaping gaps of great width. This eastern portion is stated to have been in Cretaceous times of limited extent and to have derived most of its vegetation from the land surfaces to its north and north-west, in fact from the Indo-Malayan region.

Professor Tate in his address to Section D. of the Aust. Assoc. for the Advancement of Science in Sydney, 1887, divides the flora of Australia, as follows :—

I. Immigrant.

- a. Oriental.
- b. Andean.

II. Endemic.

- 1. Euronotian or eastern.
- 2. Autochthonous or western.
- 3. Eremian or central.

He says that between the Euronotian and Autochthonian a barrier always existed ; in Cretaceous times it was to a large extent lacustrine, later on the lakes dried up and the present desert barrier formed.

His conclusions are : (1) that the Australian flora is of high antiquity ; (2) that the Autochthonian constituent was dismembered in Cretaceous times and, (3) that the Euronotian constituent was modified during very early Tertiary times by a primitive cosmopolitan flora.

I do not see much to dispute in the above except the supposed existence of a cosmopolitan flora, which is a mere assumption.

Now let us see what is to be learnt from the study of fossil plants as to the former land surfaces of the southern hemisphere.

In the Australian Coal Measures, which are now acknowledged to be of Permo-Carboniferous age, there is a remarkable absence of the plants which abound in contemporaneous beds of the northern hemisphere, but instead of this we meet with an enormous development of *Glossopteris*, *Gangamopteris*, and other genera of ferns which do not occur in the northern hemisphere till a much later epoch. These forms are found over a very large area of the earth's surface, not only in Australia, but also in India and South Africa, and it has been recently announced that a remarkable affinity with the Australian and Indian Carboniferous fern flora has been traced in Argentina in South America.

Judging from these facts, there is little doubt that in Permo-Carboniferous times an isolated Austral region of vast extent existed.

The discovery just referred to can be best described by quoting from a Note in "Nature," Vol. LII., p. 523 ; and its importance is expressed in an extract from a letter of Mr. W. T. Blandford to the same journal, Vol. LII., p. 595 :—"The latest number of the *Records* of the Geological Survey of India contains a translation of a paper by Dr. F. Kurtz on the Lower Gondwana beds of Argentina (from *Revista del Mus. de la Plata*). In this is recorded an important discovery of plant remains in shales at Bajo de Velis. These fossils are well preserved, and while being quite different from the Argentine plant-remains already found, show a close affinity to the plants of the Kaharbari beds of the Lower Gondwanas of India, as well as to those of the Ekka-Kimberley beds of South Africa, the Newcastle and Bacchus-Marsh beds of Australia and the Mersey beds of Tasmania. The previously known plant-bearing beds of Argentina consisted of two series—one containing a Rhaetic flora, resembling that of the Stormberg (Upper Karoo) beds of South Africa, the Hawkesbury beds of Australia, and the Rajmahal (Upper Gondwana) series of India; the other containing a flora of Lower Carboniferous character. The newly discovered flora must be intermediate in age between those two—that is to say, it cannot be older than Upper Carboniferous, nor younger than Triassic; and with it must go the flora of the important coal-bearing Upper Gondwana beds of India. These have already been assigned to the Upper Carboniferous (at lowest) by Messrs. Medlicott and Blandford, and the Indian Survey, and the new discoveries in Argentina give a satisfactory confirmation of their views."

Writing on this discovery Mr. W. T. Blandford says (see "Nature," LII., p. 595):—"It is difficult to understand how two floras, differing from each other far more widely than do any two continental floras living on the earth's surface at the present day, can have co-existed, unless there was for a long period of geological time a great southern continent—the Gondwana-land of Suess—

isolated by a wide sea, probably an ocean, from the land that occupied in Carboniferous and Permian days so wide an area in the northern hemisphere. The importance of the new discovery is the immense extension that is given to Gondwana land and the proof it affords that the region with its flora extended to the western hemisphere and included a part at all events of South America. This appears to indicate that a considerable area now occupied by ocean in the southern hemisphere was land in the Carboniferous period. Further research is needed to show whether the various tracts of Gondwana land were connected by a South Polar land area."

A region like the above if of long continuance would form a favourable centre of development for the higher forms of vegetation. We have already indications that Dicotyledons existed in the southern hemisphere at an earlier age than in the northern. Is it not therefore possible that the *Proteaceæ*, at least, which, as Bentham has shown, represent—especially the Tribe *Nucamentaceæ*—a very ancient type, may have here originated? While the connection of this land with South Africa and Australia continued, opportunity would be afforded for the colonisation by *Proteaceæ* of both countries, and the subsequent subsidence of the connecting links would result in the present separation into two divisions of one group of plants. The close alliance of other groups of phanerogams in South Africa and Australia has been already referred to, and there are not wanting botanists who consider that it was in the southern hemisphere that the evolution of the higher orders of plants commenced.

The *Conifereæ* are a very ancient group, and they do not appear to furnish reliable data from which the distribution of land and water in past ages can be deduced. *Conifera* make their appearance in Carboniferous times both in the northern and southern hemispheres. *Araucaria* comes into view in the Jurassic Period in the northern hemisphere. The genus is a remarkable instance of persistence of type, a character which also applies to the species. In China remains closely allied to our *Araucaria Cunninghamii* have been found, and in the Bagshot Sands at

Bournemouth in England branchlets and scales have been discovered which are scarcely distinguishable from those of our species abovenamed. Fossil remains of the genus have been found in Europe, North America, China, the extreme south of South America, Tasmania, E. Australia, and even the Island of Kerguelen. Living species occur in North-east Australia and adjacent islands, Chili and Peru.

The genus *Dammara*, the best known example of which is the New Zealand Kauri, now exists in Queensland, New Zealand, Borneo, Celebes and the Philippines. Remains obtained from the Cretaceous rocks of Greenland have been referred to this genus, but the identification is somewhat uncertain.

Araucaria is not typical of any country; and the same may be said of that other ancient group the *Cycadeæ*, which have had a world-wide distribution. It is necessary to draw attention to this, as the fact of their existence in certain strata in the northern hemisphere has assisted in the drawing of false comparisons between the tertiary vegetation and climate of Southern England and those of Australia of the present day.

The first undoubted appearance of Dicotyledons in Europe is in the Upper Cretaceous Beds, and there they are found in large numbers, as if an invasion of those forms after collecting strength elsewhere had just taken place.

The oldest examples of dicotyledonous plant remains in Australia hitherto brought to light are some obtained by Mr. H. C. Stokes about three years ago in some railway cuttings near Brisbane. These fossils were sent by Mr. Etheridge to Baron Ettingshausen, who pronounced them to be of Upper Cretaceous age from a consideration of their character which resembled European specimens from strata of that age. Mr. Etheridge informs me, however, that the beds in question are considered by Mr. R. L. Jack, Government Geologist of Queensland, to form part of the Ipswich Coal Measures, and as such are of Early or Middle Mesozoic age.*

The whole of the facts having reference to the distribution of plants and animals in the southern hemisphere seem to point to

* Geol. & Pal. of Queensland and New Guinea, p. 597.

the existence through long periods of geological time of large areas of land surface, and the discovery of dicotyledonous plant remains in the Ipswich Coal Measures containing types similar to those existing in Australia at the present day and the absence of any such fossils of corresponding age in the northern hemisphere point to the same conclusion. It seems highly probable that we have in store for us a series of most interesting discoveries whereby we may have revealed the primitive types of the Angiosperms and be able to trace at any rate their ancestry some considerable way back.

In the Journal of Botany, 1865, there is a translation by Seemann of a remarkable and sensational address delivered in 1861 by Professor Unger of the University of Vienna to his students, entitled "New Holland in Europe." In this address Unger gives an account of the supposed identity of a portion of the European Eocene flora with the existing flora of Australia. This was the first clear exposition of a theory which has found favour with certain European Botanists, although strongly contested by others.

Wesel and Weber had some years before this written a paper on the vegetable remains from the brown coal of the Rhine, and an abstract will be found in the Quarterly Journal of the Geological Society, Vol. XV. Hooker in a note on this subject in the Introduction to the "Flora of Tasmania" says:—"The Australian genera include *Eucalyptus*, *Casuarina*, *Templetonia*, *Banksia*, *Dryandra* and *Hakea*. I am not prepared to assert that these identifications or the Australian ones of the Mollasse are all so unsatisfactory that the evidence of Australian types in the brown coal and Mollasse should be altogether set aside; but I do consider that not one of the above-named genera is identified at all satisfactorily, and that many of them are not even problematically decided."

Unger begins his address by contrasting life at the present day in Australia with that of Europe, pointing out that in the one you have the lowest types of mammals and the lowest types of man as compared with the highest orders of mammals and the highest civilized man in the other, and then enters into a diatribe against

this "despised, decrepit, or scarcely born fifth quarter of the world" showing I venture to say much ignorance in so doing. He afterwards states that what was begun in Australia was transported to Europe by some supposed land bridge and there destroyed while Australia stood still, and the latter is now being threatened with almost total extinction, like the Pacific Islands. The Australian types represented in Europe were, according to him, Proteaceæ, Epacridæ (through one leaf), Santalaceæ, Coniferae and other orders. *Araucaria* is especially mentioned as abundant in some of the beds of Europe, and then he argues that the conditions which allow of these types now in Australia must have existed in Europe in Eocene times, and concludes that the climates were similar. He seems ignorant of the fact that *Araucaria Cunninghamii* grows in the humid brushes of the coast region, while *Banksia* and other genera are adapted to flourish under drier continental conditions and poor soil.

Unger requires other bridges for the explanation of his theories and one of them is that by which he supposes the European flora obtained a contingent from America, namely Atlantis.

The opinion that there was an identity of forms in Europe in Tertiary times and Australia of the present day took deep root, and was still held by Heer, and is now by Ettingshausen and others in spite of the fact that other botanists equally distinguished have proved the fallacy of the idea.

Among these latter is Bentham, whose work on the Australian Flora specially entitles him to authority. All Bentham's Presidential Addresses to the Linnean Society are of the highest value, and the one delivered in 1870 in which he specially devotes himself to the subject in hand, should be read by all interested in this subject. In it he ably contests the new views, and referring to Unger's tabular pedigrees of European forest races, he says that his speculations have been deduced much more freely from conjectures than from facts, and he mentions that the great majority of fossil species are established on the authority of detached leaves or fragments of leaves alone. He then points out the unreliability of determination by leaves alone, and how even DeCandolle had

been in error even as to natural orders of specimens of which he possessed leaves alone, and he refers to Professor Flower who had pointed out that leaves belong to a class of structures that are aptly designated adaptive as opposed to essential. He next points out that some of Heer's determinations of *Podogonium* of the Caesalpinaeae where specimens of leaves, fruits, and even flowers, some of them still attached are conclusive, and that from their relation to existing plants point to certain conclusions as to climate ; but in dealing with the reputed Australian groups he is strongly adverse. Speaking of Proteaceae, he says "I have no hesitation in stating that I do not believe that a single specimen has been found that a modern systematic botanist would admit to be Proteaceous unless it had been received from a country where *Proteaceae* were otherwise known to exist." As Mr. Bentham was especially engaged at the time in the examination of Proteaceae, I cannot do better than make one or two short quotations in order to give his own words. "The analysis and detailed descriptions I have had to make within the last few months of between four and six hundred *Proteaceae*, and consequent investigation of their affinities and distribution have shown that the Order, as a whole is one of the most distinct and most clearly defined amongst Phanerogams. I do not know of a single plant intermediate in structure between that and the nearest allied Orders which I cannot say of any other of the large Orders I have worked upon. There is, moreover, especially amongst the *Nucamentaceae* a remarkable definiteness in the majority of genera without intermediate species, whilst the whole Order exhibits the greatest uniformity in some of its most essential characters, derived from the arrangement of the floral organs and the structure of the ovary and embryo, accompanied by a truly protean foliage. All this points in my mind to unity of origin, very great antiquity and long isolation in early times." Speaking of the so-called fruits of *Hakea* and *Embothria* as determined and figured by Ettingshausen but of which the internal structure is not visible, he says that some are "quite as much like those of several *Coniferae*, or of certain genera of *Meliaceae*, *Sapindaceae* and various other Dicotyledonous

orders" and others "have a venation of the wing very different from that of any *Proteaceæ* I have seen, and much more like that of a real samara of an ash." After discussing many examples he says, "From the above considerations I cannot resist the opinion that all presumptive evidence is against European *Proteaceæ*, and that all direct evidence adduced in their favour has broken down on cross-examination; and however much these Eocene leaves many assume a general character which may be more frequent in Australia, (in *Proteaceæ* and other orders) than elsewhere, all that this would prove would be, not any genetic affinity with Australian races, but some similarity of causes producing similarity of adaptive characters."

The above remarks from a botanist so eminent and experienced in questions of the Australian flora as Bentham might well have been thought conclusive, but we find that Ettingshausen in 1890 brought out a work entitled "Das Australische Florenelement in Europa" in which he reasserts the existence of *Leptomeria*, *Casuarina*, *Exocarpus*, *Banksia*, *Dryandra*, and *Eucalyptus*.

The subject of fossil plants and their identification is ably treated in the "Handbuch der Palæontologie," Part II entitled "Palæophytologie." This work as stated on the title page was begun by Herr Schimper, formerly Professor at the University of Strassburg, continued and concluded by Herr Schenk, Professor of Botany at the University of Leipzig, and edited by Professor Zittel of the University of Munich. It was published in 1890.

Doubt is thrown on the identification of *Casuarina*, *Bursaria*, *Hibbertia*, and *Callicoma*. Speaking of the remains attributed to the capsular *Myrtaceæ*, Zittel says there is no necessity to fly to that explanation. As to *Proteaceæ* the conclusion appears to be the same as that of Bentham. The identification of *Leptomeria* is spoken of as being due to superficial resemblance to which weight is given without critical inquiry. I have looked carefully through Zittel's work and I cannot find that the correctness of the identification of any Australian forms is acknowledged except some fossils of the Upper Cretaceous which have been classed and named *Eucalyptus Geinitzii*.

It is to be observed therefore that all resemblances to Australian existing vegetation in the Tertiary flora is looked upon by Hooker, Bentham, Zittel and many others as fanciful and unproved. As regards the supposed *Eucalyptus Geinitzii* it will be noticed that the figure in Zittel's book reminds one of the style of growth of a Eucalypt, but the fruits are by no means like what exist at the present day. It is, however, just possible that here we have something like an ancestral example of the capsular *Myrtaceæ*, or indeed of the whole group of the *Myrtaceæ*, for it may be assumed that the fleshy-fruited section of the order developed by natural selection out of the hard-fruited one—community of type no doubt implies community of origin. There is, however, an element of doubt about the whole matter, as it is strongly to be suspected that the immediate ancestors of *Eucalyptus* in Australia had opposite leaves.

Be that as it may, however, there is nothing to prove that in Tertiary times any of the typical Australian groups existed outside Australia.

Pliocene fossil remains from Victoria have been investigated by Professor McCoy and Baron von Mueller; also specimens from Orange in this colony. The parts described consist of fruits and a few leaves. But Baron von Mueller has, I believe, steadily refused to classify leaves or fragments of leaves, and condemns the practice.

Some fossil plants from Dalton, near Gunning, and Vegetable Creek, in New South Wales, were sent by the late Mr. C. S. Wilkinson, Government Geologist, to Professor Ettingshausen, and they have been examined and reported upon by him. Professor Ettingshausen's two memoirs on the subject have been published in English by the Mines Department of Sydney in one volume, the book being edited by Mr. Robert Etheridge, Junr., now Curator of the Australian Museum.

The fossils consist almost entirely of leaves, and the strata are according to Mr. Wilkinson of Upper Eocene or Lower Miocene age, while those examined by Baron F. von Mueller are of Pliocene age. Mr. Etheridge does not accept any responsibility as to

identification from leaves. Baron Ettingshausen's conclusions are as follows :—He finds 98 species representing Cryptogams, Monocotyledons, Gymnosperms and Dicotyledons; and as he says the most important general result is this :—

“The Tertiary Flora of extra-tropical Australia is, as regards character, essentially different from the present living flora of Australia; nor does it closely resemble, in general, any other living flora. On the other hand, it shows the mixed character of the Tertiary Floras of Europe, the Arctic Regions, North America, and probably all the Tertiary Floras. It has also much more similarity to the Tertiary Floras at present known than to the existing flora of Australia. The characteristic plants of Australia are but feebly represented.”

He finds such genera of the northern hemisphere as *Myrica*, *Betula*, *Alnus*, *Quercus*, *Fagus* and *Salix* represented. Of these we have at the present day *Fagus* only. There are other genera of East Indian origin, which is not to be wondered at, as we have such at the present day; but he also finds species of *Magnolia* allied to North American forms; *Bombax* of tropical America and some Oceanic genera which I think are much more doubtful.

These and other conditions seem to indicate to him an original universal flora in Tertiary times to which all the present existing floras of the earth may be traced back, and the evolution of the present flora from the Tertiary flora took place through the differentiation of the “floral climate”—whatever that may mean—which, however, was effected differently in different parts of the globe. (See History of the Development of the Vegetation of the Earth. Sitzungsab. der Acad. der Wiss. Wien).

As already referred to, further investigation has been made by Baron Ettingshausen as to some fossil plant remains found when excavating some railway cuttings near Brisbane rather more than three years ago. This gentleman made a preliminary investigation of them and submitted a report to the Imperial Academy of Sciences at Vienna on the 13th April, 1893. The presence of many of the Tertiary forms is apparent, and among them

Myrica, *Quercus*, *Fagus*, *Cinnamomum*, *Banksia* and *Eucalyptus* are found to be well represented.

I have not seen these, but I have carefully looked into the matter of the Dalton and Vegetable Creek fossils, and I cannot agree with the crucial determinations of Professor Ettingshausen, and I believe that his conclusions as to the character of the flora and its resemblance to the flora of other parts of the world are utterly wrong.

With the aid of Mr. R. Baker, F.L.S., of the Technological Museum, I have made comparisons between the fossil leaves and living ones, and so far as I have gone I find that the various types of fossil leaves are represented among existing plants and that there is no reason to go outside Australia to look for them. But even supposing the existence of the northern genera in Australian strata could be undoubtedly shown, Ettingshausen's deductions are still not valid, for *Alnus*, *Acer*, *Quercus*, *Myrica*, and others have to-day a wide range which brings them almost into close proximity to the Australian region, while species of *Quercus* have been actually proved to exist to-day in New Guinea, which is in the Australian region.

This portion of my Address has taken up so much time that I cannot on the present occasion do more than refer to one or two instances of what I consider faulty identifications, but I hope that during the ensuing year I may be able to present to the Society some further notes on the subject.

Fig. 1, Plate III., in Ettingshausen's work is named *Cinnamomum Leichhardti*, but the leaf represented is much more like that of *Smilax australis* or a species of *Rhipogonum*. It is not safe to conclude that all leaves with the *Cinnamomum* venation belong to that genus. *Litsaea dealbata*, which grows as far south as latitude 34°, and on Mt. Wilson at an elevation of 3,600 feet, and is not indicative therefore of tropical conditions, has the same venation. Baron Ettingshausen's specimens of *Acer* are much more likely to belong to *Sterculia*. The *Alnus* fruit it has been shown is probably a fragment of an *Araucaria* branchlet,

and the leaves attributed to *Betula* might equally well belong to say *Pomaderris betulina*.

There are many other examples which I have not time to give in detail now, but I have little doubt that all or nearly all the fossil leaves can be shown to possess the form and character of existing ones in the brush forests at the same latitude on the coast, and there is no necessity to search the world over for resemblances.

As to the statement that the Australian types are not proportionately represented, it is only a pity that Baron Ettingshausen is not better acquainted with the Australian flora of the east coast. He would find that in the dense brush forests of the coast Eucalypts and *Proteaceæ* become choked out and their place is taken by other types from the north. It is only necessary to suppose that the vegetation of the coast extended inland as far as Gunning or Vegetable Creek, a circumstance very likely to happen in the moister Miocene times, and one might have leaves preserved not of the open forest or scrub where the Australian types abound, but that of the brushes where the same are rare.

It is clear from the above considerations that the existence of the universal flora of mixed types assumed by Heer and Ettingshausen is not proved and that the extraordinary sorting operation which the "floral climate" was supposed to effect is grossly exaggerated. The absurdity of the supposition with regard to Australia seems to me extreme when it is remembered how many climates (not one alone) varying between hot and cold, moist and dry, Australia possesses. Eucalypts and other trees grow from east to west and from north to south of the country under the most variable conditions, and they will grow in other countries in the greatest luxuriance.

Further investigation of this subject should be persisted in, and the Tertiary and earlier beds of Western Australia may be looked to to throw light on the subject.

At present the facts seem to afford grounds for concluding—

(1) That many, if not all, the typical Australian floral types originated in Australia or in some land connected with it, but now submerged.

(2) That the assumption of the existence of a universal flora of mixed types at any epoch is unfounded.

(3) That the fossil plant remains of Tertiary age in Eastern Australia indicate a vegetation in all respects similar to that existing on the coast in the same latitude at the present day.

To them might perhaps be added a fourth conclusion of less certain character, but of high probability, that the *Proteaceæ* represent a most ancient type which had their origin at a time when not only extensive areas of land existed in the southern hemisphere but when some kind of connection more or less lasting existed between Australia and South Africa.

I take this opportunity of pointing out the danger of forming conclusions as to former climates from the character of vegetable remains. It has been not infrequently assumed that because leaves of *Cinnamomum* or other tropical types are found the climate must have been tropical, although the value of the argument is at the same time nullified by the acknowledged presence of leaves such as *Alnus* and *Betula*, belonging to the cooler temperate regions. The European temperate flora of the present day is very distinct from the tropical—it is cut off from the tropical flora of the same longitude by transverse mountain barriers and the Sahara desert, but on other parts of the earth's surface there does not exist this marked division. On the Pacific Coast of Asia tropical types reach Japan, while temperate types have advanced south into the tropics. Tropical types invade the valleys of the Himalayas, and on our east coast the same intermingling of types occurs. In Tertiary times probably these barriers to the spread of the different types did not exist in Europe and the tropical vegetation of the south or south-east was enabled to invade temperate latitudes as is the case on the eastern coast of Asia at the present day.

I should like to induce Members of our Society to urge upon their friends scattered throughout the country to report any geological or palæontological discoveries which may come under their notice. There are so many interesting facts to be elicited, and the geological record in this country of ours is so broken up

and detached that when information can be obtained it is very precious. It often happens that fossils are found by those who are entirely ignorant of their value, and they are looked upon as fossils and nothing more, as if they were not each of them bits of history to be carefully treasured. If they are carried home they lie about for some time and are eventually lost. Such relics should be carefully preserved, the circumstances and manner of the find in each case noted and reported to the Department of Mines. I am certain that many interesting discoveries are lost to science through neglect or ignorance.

Another work that requires carrying out more fully and over a larger field than at present is the formation of local herbaria, including the forwarding of duplicate specimens to Sydney for identification. The knowledge of the distribution of plants in this country is far from complete, but it is a most interesting and important subject. Ladies residing in the interior, many of whom I know find their time hang heavily on their hands, would earn the gratitude of the scientific world if they would undertake to carry out this object, which would be more an amusement than a toil. Many districts are out of reach of ladies, and must be explored by the sterner sex. Local officers of the Government service should also be expected to assist. The great army of forest rangers, surveyors, road superintendents and others might have this work made part of their duties. Whenever an important commission is sent by the British Government for geographical research into a little known country, for the delimitation of frontiers or other serious work, a man of science is invariably sent to assist in the expedition. In this case as it were we have the new and undiscovered country close at hand. Why should we neglect our opportunities?

The additions to our knowledge of the natural history of Australia directly resulting from the operations of the "Horn Scientific Expedition to Central Australia" promise to be of the greatest interest and importance. Captain Sturt, the pioneer explorer in this region and its outskirts (1844-46), was also the first to furnish some insight into its natural history. In an

appendix to his "Narrative of an Excursion into Central Australia" he enumerates 10 species of Mammals, and 141 species of Birds met with during the course of the expedition. In the botanical appendix in the same work, R. Brown states that the collection of plants comprised about 100 species, though he enumerates but 26, chiefly the new genera and species represented. The discovery of the Alexandrine Parrakeet, and especially of *Notoryctes*, may certainly be allowed to count for a good deal; but otherwise it must be confessed that the supplementary zoological knowledge gained during the half-century which has since elapsed has not amounted to very much; and the progress made compares unfavourably with the advance in other branches, particularly in botany. Not many explorers in later days have failed to come within range of the persuasive influence of Baron von Mueller; and Professor Tate has been indefatigable in his efforts to accumulate natural history data in respect of both Tropical and Extra-Tropical South Australia. Consequently lists of plants with other botanical information will be found in almost every explorer's account of his travels, or in the Transactions of the Royal Society of South Australia. But we may look almost in vain for corresponding contributions to zoological knowledge. This, however, is not altogether a matter for surprise when allowance is made both for the natural advantage which the botanical collector has over his zoological confrère, and for the special difficulties—of collecting and preserving, as well as of transport—which have usually attended the steps of travellers in this part of the Continent, especially before the introduction of camels. Hence beyond the descriptions of a few miscellaneous species, which from time to time have come into the hands of zoologists, almost the only contributions supplementary to the information supplied by Sturt are (1) the lists of the incomplete collections of birds and molluscs obtained by Mr. F. G. Waterhouse; (2) Mr. Sanger's notes on the mammals and a few other forms, specifically undetermined, observed during two years' residence at Cooper's Creek; (3) Dr. Stirling's paper on *Notoryctes*; and (4) the important Reports of the Elder Expedition. This expedition, however, was persistently

attended by dry weather; its circuit took in West Australia, and its single naturalist had to divide his attention between botany and zoology.

There was, therefore, ample scope for a well-organised attempt to throw more light on the natural history of this remarkable tract of Australia. At the Adelaide Meeting of the Australasian Association, Prof. Tate, in his Presidential Address, expressed the earnest hope that "a systematic exploration of some well-known area, such as the MacDonnell Ranges," might become possible on the part of a well-known South Australian patron of exploration "as a crowning effort to unfold some of the mysteries of our dry interior." Not quite in the way Professor Tate had in his mind, but for practical purposes in an equally satisfactory way, through the liberality of Mr. Horn, the attempt was shortly afterwards made. And with what conspicuous success we may judge from the first instalment of the Report of the Expedition—Part ii. Zoology (4to. pp. 1-431, with 22 plates), edited by Professor Baldwin Spencer, recently issued. To this important work some little attention may worthily be devoted.

Leaving out of consideration the Hymenoptera (other than the Honey Ants) and the Hemiptera, the returns for which are not completed, we find that the Horn Expedition has added some 164 new species (Vertebrates 30, Invertebrates 134) to the general fauna of Australia. Taking all things into consideration this is a very substantial gain. Central Australia is not a region which could be expected to yield a varied fauna very rich in species. Some groups, well represented in other parts of Australia, but requiring a more or less humid environment, seem here to be wholly wanting, or but feebly represented.

As a contribution to the fauna of a particular circumscribed area of the Continent—the central portion of the Eremian Region, Larapintine Region as Prof. Tate now proposes to call it—the results are even more important. Again, leaving out of consideration the Hymenoptera (other than the Honey Ants) and the Hemiptera, we find a total of between five and six hundred species (Vertebrates 177, Invertebrates 358) assigned to it. This

at first sight seems a not very large census; and no doubt in time and under very favourable circumstances it will be to some extent increased. Every naturalist who resides for some time even in a good collecting district knows how long a time it takes to arrive at a complete census of the groups of its fauna in which he is especially interested; and how his experiences vary from year to year and from season to season. Still less is it likely that the zoological resources of an enormous area like Central Australia should be exhausted at a single attempt by visiting naturalists almost constantly on the move, however enthusiastic and assiduous they might be. From the experiences of Prof. Spencer we gather that if a zoological collector in Central Australia is to be successful in getting together a collection—not merely of skins of beasts and birds—but one at all representative of the general fauna, questions of time and patience must be of quite secondary importance. First of all he has to catch his animals—but in some seasons, and in the case of some of the most interesting members of the fauna, this is an unusually difficult task, and may entail long and patient waiting upon the rains, as well as securing the cooperation of the Aborigines. Should he arrive in a dry season he might without previous experience even wonder whether, except ants, there were any animals to be caught. The visit of the Horn Expedition was made during the winter months (May-Aug.) after good rains. But during the course of the expedition the rain kept off, the result being that a number of forms were overlooked, and many experiences were missed, and would have been missed altogether, had not Professor Spencer on his own account subsequently made a rapid supplementary journey to Charlotte Waters in time to see some of the more important but transient aspects of the transformation scene which the advent of good rains brings about.

Looking at the Larapintine fauna as a whole, we find it characterised by both negative and positive features. The negative characteristics are shown by the absence of many widely distributed Australian forms, or among the higher groups by the limited number of species of the types which do occur, or by the

complete or almost complete absence of representatives of orders which are abundant in other parts of the continent. This state of things is sufficiently accounted for by the arid nature of the country and its unsuitability for their maintenance, or by the effectual climatic barrier which keeps them out. Thus, it would seem that with the want of suitable perennial rivers and creeks may be correlated the absence of *Platypus*, just as the absence of forests accords with a dearth of arboreal *Phalangers*. Land *Planarians*, *Peripatus*, Terrestrial *Amphipods* and *Isopods*, and *Slugs* are among the other notable absentees (as well as *Myriopods*—possibly an unintentional omission).

Earthworms are poorly represented, only one species having been found. This—a species of *Acanthodrilus*—is a treasure which in quality compensates for some of the deficiency in quantity. It is a good instance of discontinuous distribution, and furnishes Professor Spencer with an opening for some interesting speculations. The genus is one which in Australia has lost ground, being at present but feebly represented in a few widely separated localities. Formerly when the rainfall was greater it was probably the dominant genus in the northern portion of the Continent, as it still is in New Zealand and elsewhere in the Southern Hemisphere.

Butterflies and *Lepidoptera* generally are not numerous represented. But the collection was made during the winter months, or rather during a dry spell, which will perhaps to some extent account for the scarcity.

The positive characters are shown chiefly in this—that the Larapintine fauna is a select assemblage of species which may perhaps be roughly classified as very hardy species, and as species which in habit or in structure have become specially adapted to live in an arid region, or which have been able to take advantage of some favourable external circumstances.

Some of them doubtless are the lineal descendants of forms which have uninterruptedly inhabited the region from a time antecedent to the setting in of the Dry Period, which proved so disastrous a change to forms like the *Diprotodon*. Others are

immigrants from very various directions. The new light thrown upon these matters by the naturalists of the Horn Expedition is one of the distinctive features of the Report. We get as it were hints and glimpses of adaptive relations to special surroundings in studying the fauna of the inland portions of the eastern colonies, but in Central Australia they reach a maximum. Here the struggle for existence takes on a new aspect. It is on the whole perhaps not so much a struggle among individuals as a struggle against climate, and all that that involves. As Darwin says: "When we reach the Arctic regions, or snow-capped summits, or absolute deserts the struggle for life is almost exclusively with the elements" (Origin, 1st Ed. p. 69). In Central Australia when a really good time comes, though some species have their numbers kept down by predaceous enemies or by a percentage of their progeny failing to complete their development in time, it must, though short, still on the whole be a very good time for a considerable proportion of the fauna.

When the drying-up process sets in again, then once more begins the struggle against the elements, and the need for special adaptation comes into play. The larger mammals endowed with great vitality, such as the kangaroo and the dingo, must weather it out or travel. The smaller mammals are nocturnal in their habits, often burrowers, able to put up with a minimum water supply, and a diet of ants or of dry herbage. The frogs are especially interesting as having in most cases superadded to a strongly marked burrowing habit a remarkable capacity for storing water within their bodies. The fishes are favoured in another way. In South Australia, Victoria, and Tasmania is found the pouched lamprey (*Geotria*) which in dry seasons is said to fill its remarkably developed throat-pouch with water, and then to aestivate buried in the mud. Of the Central Australian fishes Mr. Zietz is unable to report anything so striking as this. The piscine inhabitants of isolated shallow pools become extinct in dry periods, but others survive in the deeper permanent holes whence they may be afterwards again distributed by floods. Like the Batrachia, too, they have another string to their bow in the

possible dispersion of their ova through the agency of aquatic birds. Of the fluviatile Mollusca Mr. Sanger says that the *Unios* aestivate in the mud; that the gasteropods (five species) die when the creeks dry up, but that each flood stocks the creeks again, young ones in all stages of growth being met with in the flood waters. Some of the land mollusca are remnants which have found a haven of refuge of restricted area "on the southern escarpments of the elevated land or in the deeply shadowed gorges of the same," forming single colonies, or if more then widely separated. The Crustaceans are either burrowers like *Astacopsis* or *Telphusa*, or they are Entomostracans which like *Apus* develop only after their eggs have been dried up. The Honey Ants have learned to store up honey in a remarkable way, certain workers being set apart as receptacles for the honey collected by the other workers of the community.

An elaborate series of observations extending over several successive meteorological cycles—if such were possible—would probably show a considerable corresponding ebb and flow both in regard to species and to individuals. In times of unusually prolonged and trying drought, the fauna in spite of the assumption of adaptive characters must still suffer severely; and recovery only become possible by a succession of very good seasons leading to increased fertility on the part of the survivors, or providing for the influx and establishment of immigrants.

Thus the Larapintine region furnishes an Australian phase of a state of things analogous to what obtains in arid regions in other parts of the world. In keeping with the characteristic and paramount claims of humidity, the call is for animals pre-eminently endowed with aestivating capabilities. In Central Australia in winter the winds are cold, and the nights frosty; but allowing for all this it is still a land of sunshine. It may even be called a land of perpetual summer by contrast with some parts of North America, of which Merriam says that the cold in winter is so intense that it is quite a common occurrence for trees five or six feet in diameter to be frozen to the heart. In so far as hibernation is due to the influence of intense

and prolonged cold, Central Australia makes but trivial demands upon its inhabitants in this direction. The power to withstand the effects of prolonged droughts—not merely to enter upon a “summer sleep” induced by high temperatures—in a high degree seems to be the all-important thing.

Respecting the most characteristic Eremian species a few points may be noted. Among the Mammals, *Notoryctes*, that curious marsupial modified for a burrowing habit, is pre-eminent. *Chaetocercus* hitherto known only from a unique made-up skin, and from a locality not entirely above suspicion, now appears as a new creature. The new genus *Dasgyroides* is an important addition to the fauna. Very important are Professor Spencer's interesting observations on the indications presented by some of the smaller marsupials of a diminution in the number of young produced at a birth; and also of the irregularity in their attainment of full growth due to the effect of continued adverse seasons. Among the Rodents, Mr. Waite reports a species of *Mastacomys*, a Tasmanian genus with previously only a fossil continental representative.

The Birds include the rare *Spathopterus Alexandræ*, which, with the new species, five in number, is beautifully figured. Mr. Keartland's valuable ornithological field notes are a most important feature in this section of the Report.

From the Lizards may be selected two species referable to the genera *Ceramodactylus* and *Ebenavia*—the former previously known only from India and Persia, the latter only from Madagascar. This group seems to furnish the most striking instances of colour-adaptation—if, without any knowledge of the actual surroundings, we may so interpret the unfamiliar and startling brilliance and variety of tint displayed by some of the species figured from Professor Spencer's drawings from nature. Doubtless in this, as in other cases, the narrative portion of the Report will prove to be a source of much interesting information.

From the Mollusca may be singled out a species of *Microphyura*, a genus otherwise known only from New Caledonia; which provides an attractive speculative morsel for Mr. Hedley.

Viewing the results in their relation to geographical distribution some important considerations present themselves. The range of many known species is now for the first time considerably extended. Examples are the Echidna, *Sminthopsis murina* and *S. crassicaudata*, *Antechinomys*, five out of the six frogs, some of the birds and reptiles; among invertebrates the crayfish (*Astacopsis*), the freshwater crab (*Telphusa*), *Apus*, and others of the Entomostraca; and certain molluscs and insects.

Taking the different orders separately, some curious relations manifest themselves. Among the mammals along with characteristic and ubiquitous forms there occur also species found likewise in the inland portions of one or more of each of the mainland colonies. The birds, with the exception of five new species, Mr. North reports to be chiefly species ranging over the southern half of the continent, with a slight preponderance of western forms a slight admixture of north-western species, and an absence of northern species. Among the lizards, together with Eremian and widely dispersed species, there are northern and western forms. Of the frogs, one species is new: the remaining five occur also in the interior of New South Wales or Queensland only one of them (*Hyla rubella*) extending also to West Australia. The land Mollusca, of all the Orders represented, present the largest percentage of endemic forms; their general facies approximating more to that of subtropical West Australia than to any other part of the Continent. From the limited number of genera and their peculiar distribution Prof. Tate regards them as indicating a primitive group whose insularity has long been maintained. The fluviatile Mollusca, however, present species belonging for the most part to Queensland and the Northern Territory.

Considering the fauna of Central Australia as a whole, it will be seen that the regions into which Prof. Tate has proposed to subdivide Australia from botanical considerations are not equally satisfactory from a zoological point of view. Probably no one set of regional subdivisions would entirely suit the views of all specialists.

Another interesting point is strongly brought out. Central Australia furnishes the most striking Australian instance known of the "potency of climate compared with the inefficiency of physical barriers" in regulating geographical distribution. In an interesting address "On the Geographic Distribution of Life in North America," by Dr. Merriam, this author points out that Wallace* greatly underrates the importance of temperature as a factor in determining the distribution of animal life; and he adds:—"It is now pretty generally conceded that temperature and humidity are the chief factors governing the distribution of life, and that temperature is more potent than humidity." Australia is a continental tract, completely isolated, not reaching into very high or very low latitudes, without mountain ranges sufficiently high to reach the snow line, and its shores are washed wholly by tropical or temperate seas. It would seem that Merriam's dictum will not apply to the Eremian Region. In his important Presidential Address at the Sydney Meeting of the Australian Association for the Advancement of Science, Professor Tate said:—"The chief factors influencing the geographic distribution of plants are those of temperature and moisture, because they are indispensable; of the two, so far as Australia is concerned, the latter is by very far the more important." This generalization is now shown to apply equally well to animal life.

Finally, the Report furnishes confirmatory evidence as to the past history of Central Australia, as previously sketched by Prof. Tate and others. The elevated portions of the Larapintine region have continued to be land-surfaces since pre-Cretaceous times. They were insular members of the Archipelago whose shores were washed by the Lower Cretaceous Sea during the period of deposition of the Rolling Downs formation. During the deposition of the Desert Sandstone formation in Upper Cretaceous times they remained to some extent in the condition of islands, but the marine conditions had given place to a lacustrine order of things. With a favourable climate and abundant

* Proc. Biol. Soc. Wash. vii. (1892).

rainfall the partially reclaimed lacustrine area in Pliocene times was gradually opened up to immigration, until the central region must have supported a wonderful fauna including *Diprotodon*, *Nototherium*, large kangaroos, wombats, and crocodiles, &c. Of the remarkable flora which must have coexisted for the support of the gigantic herbivores, we know even less than of the extraordinary fauna. In Post Pliocene times set in the dry period which still continues. Such members of the fauna as could not adapt themselves to the new conditions were driven out.

The Botanical, Geological, and Anthropological Parts of the Report, as well as the Narrative, are still to come. In its complete form therefore this fine work bids fair to be the most comprehensive and complete account of the natural history of any part of Australia ever issued in a self-contained form.

In conclusion it would seem not out of place to tender the hearty congratulations of this Society to Mr. Horn, and to the accomplished naturalists who took part in the expedition, as well as to the various specialists who, in the more prosaic share of working up the material, have still done what they could to crown the work of the expedition with success. The amount of zeal and hard work which Professor Spencer in a three or four-fold capacity has expended on his share of the undertaking is evident enough from a mere inspection of the Report. The style and finish of Mr. Wendel's plates, mostly reproduced from drawings by Professor Spencer, as well as the letter-press, are as much a source of satisfaction as the contemplation of the fact that except in two groups it has not been necessary to go outside the limits of Australia to find specialists able and willing to undertake the necessary systematic work.

On the motion of Mr. R. Etheridge, Junr., seconded by Mr. J. H. Maiden, a very hearty vote of thanks was accorded to the President for his interesting Address.

The Hon. Treasurer read the financial statement of the Society's accounts. The report of the Auditors could not be presented, as one of them was still unavoidably absent from Sydney on official business.

The following gentlemen were elected

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E. G. W. PALMER.

The Meeting was then adjourned to April 29th at 8 o'clock
p.m.

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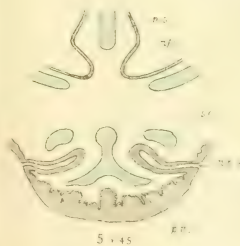
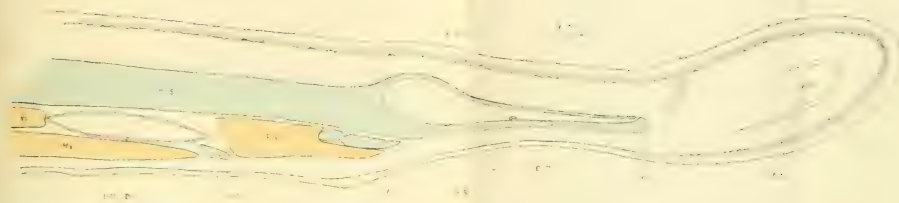




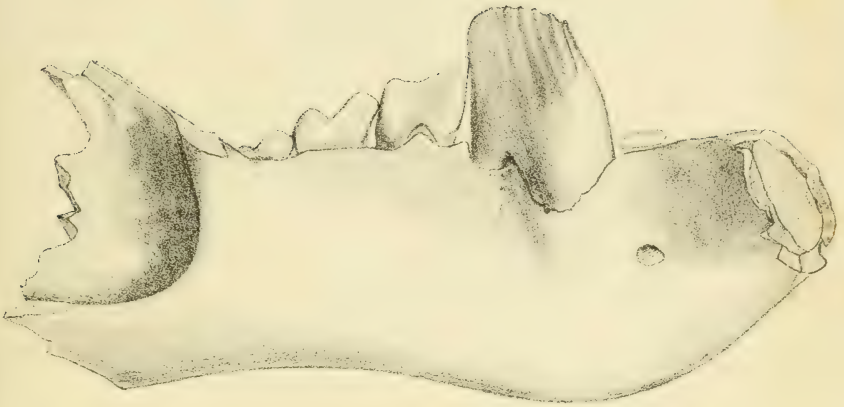
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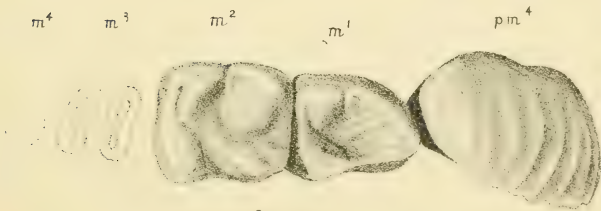




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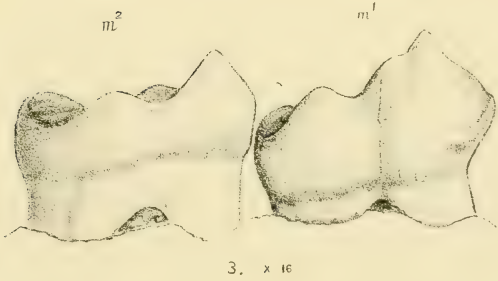
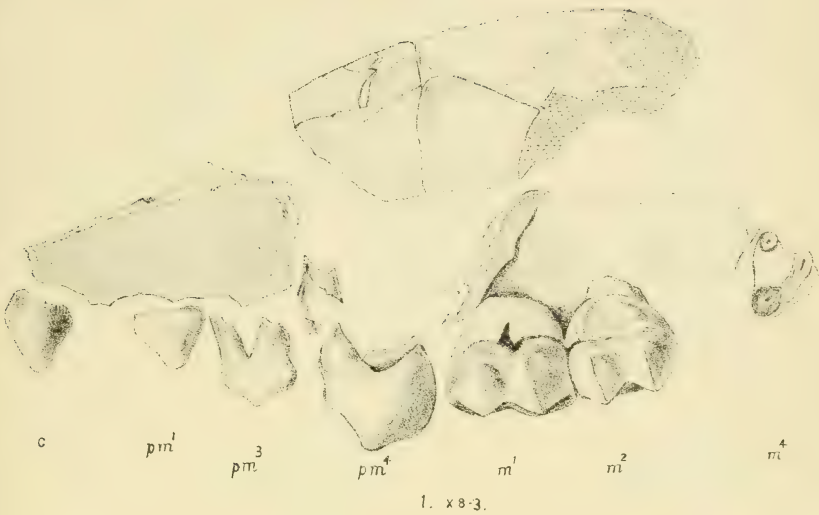
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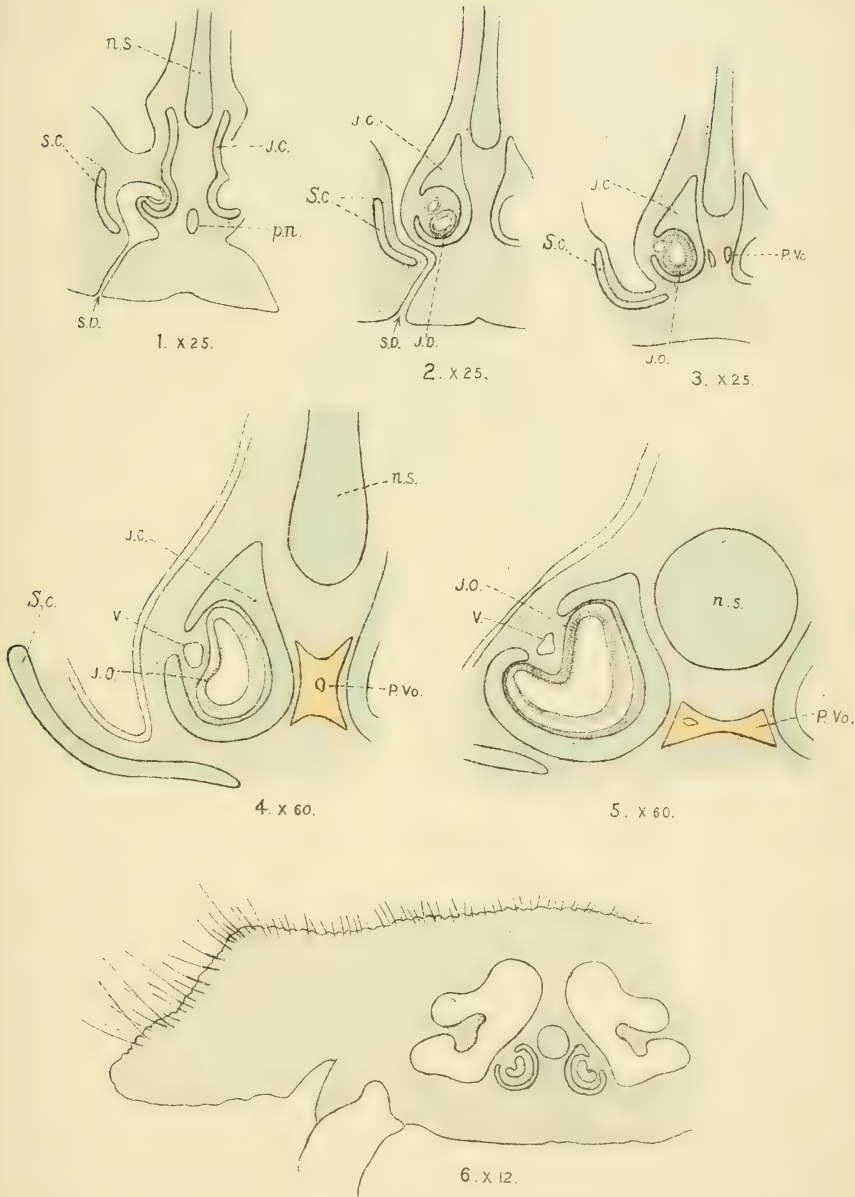
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PALÆOPETAURUS ELEGANS.



R.B. del.

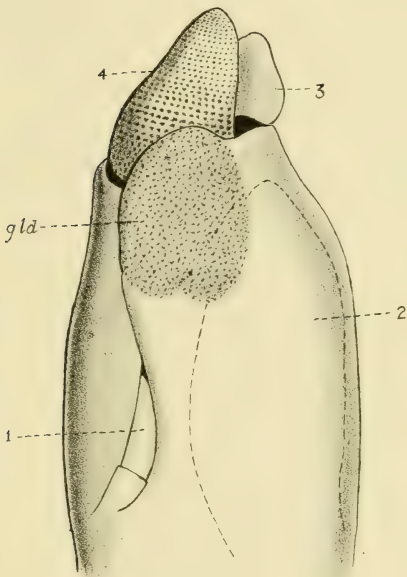
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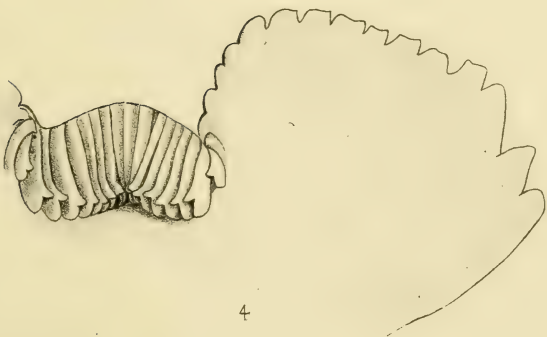
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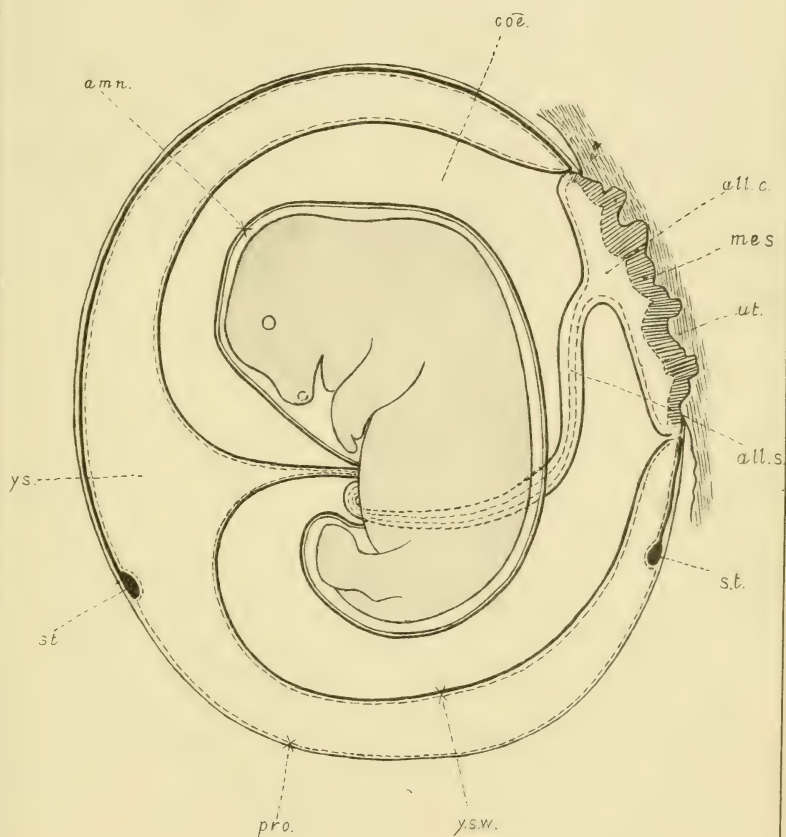
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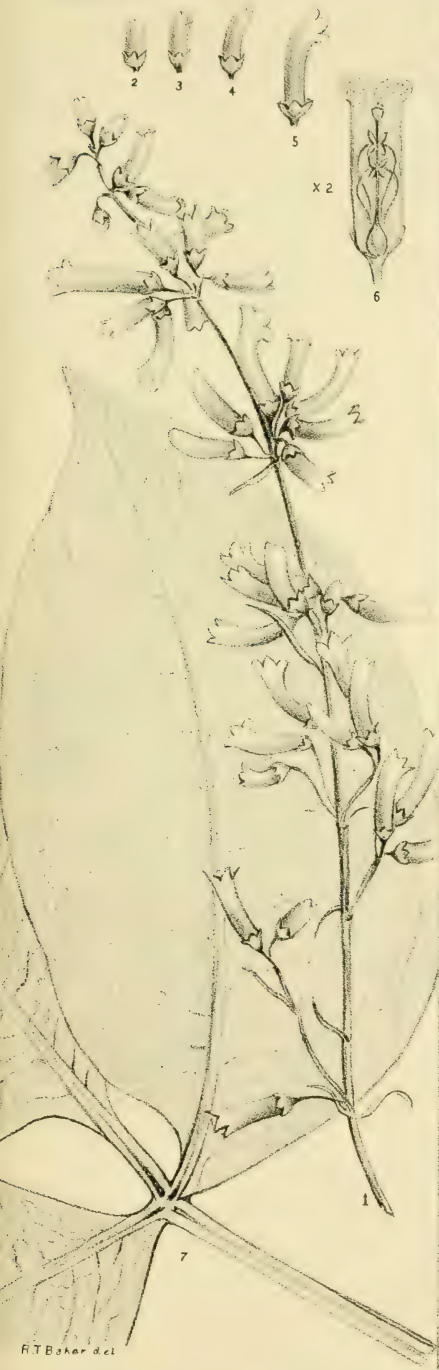
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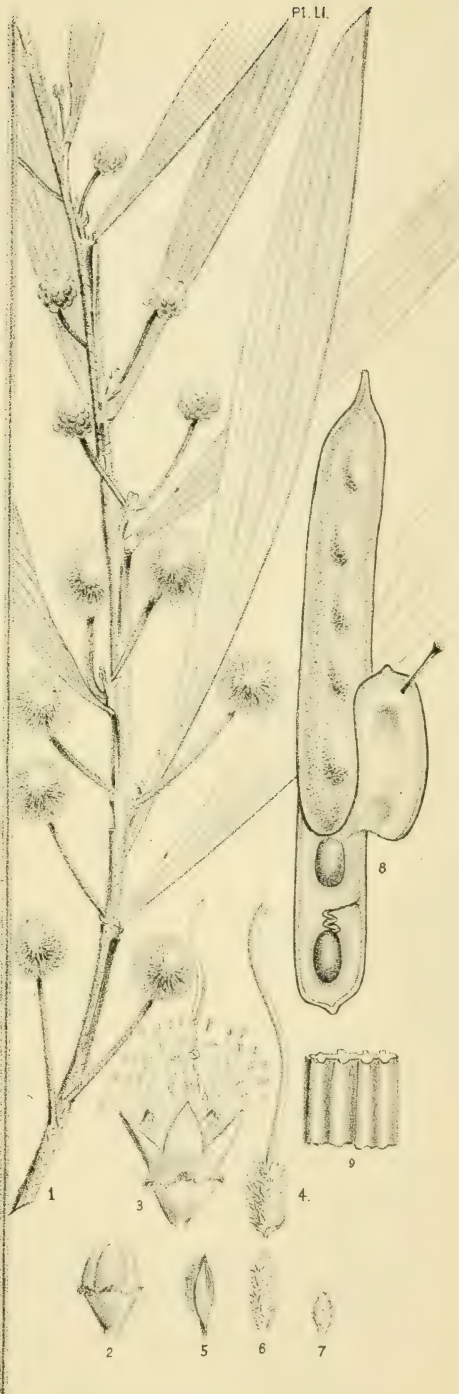


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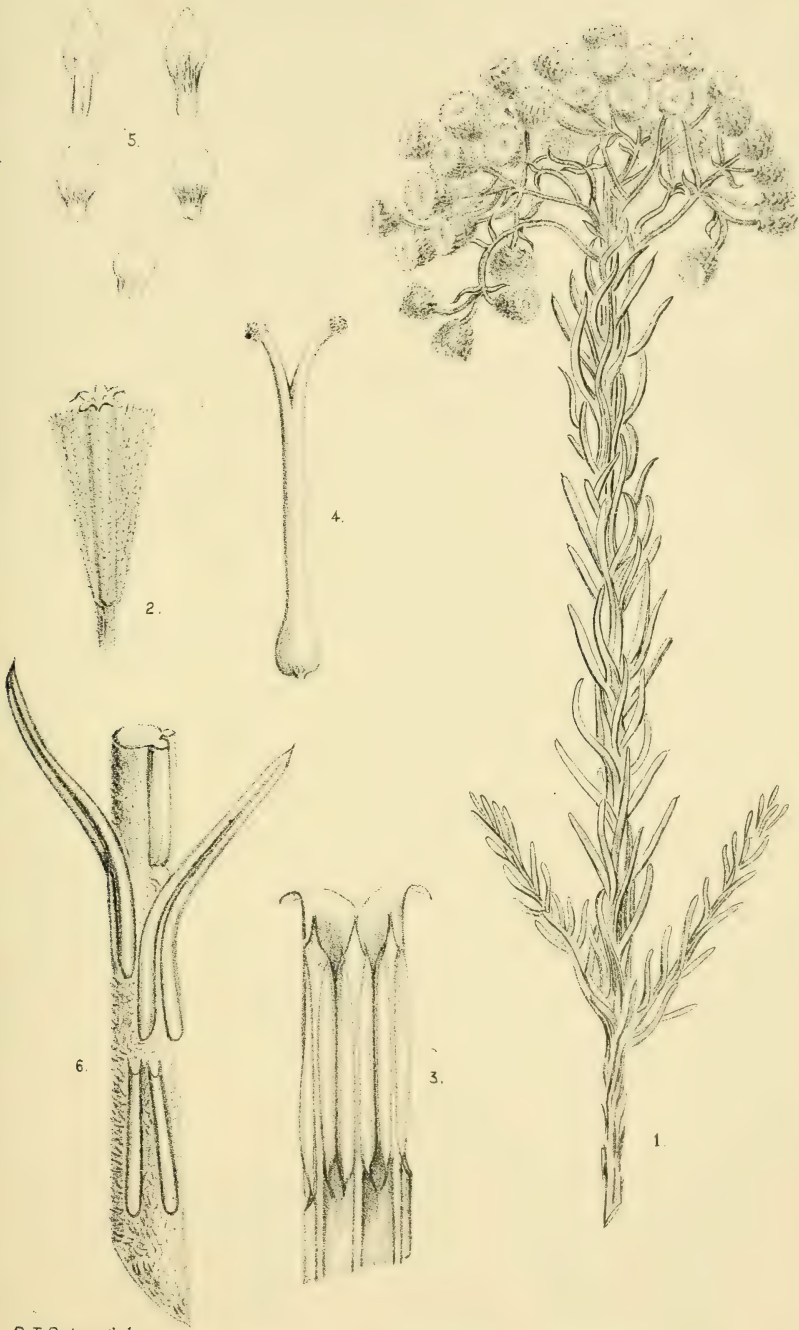


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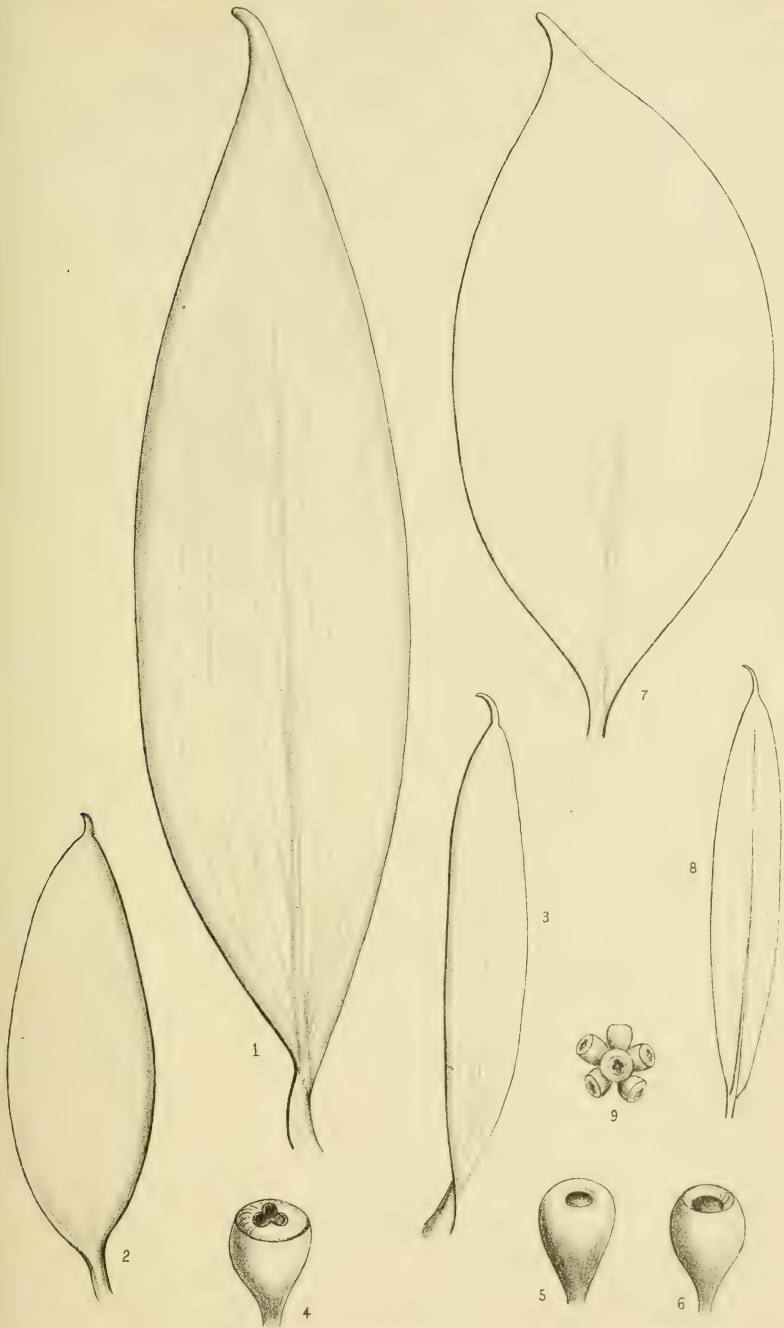


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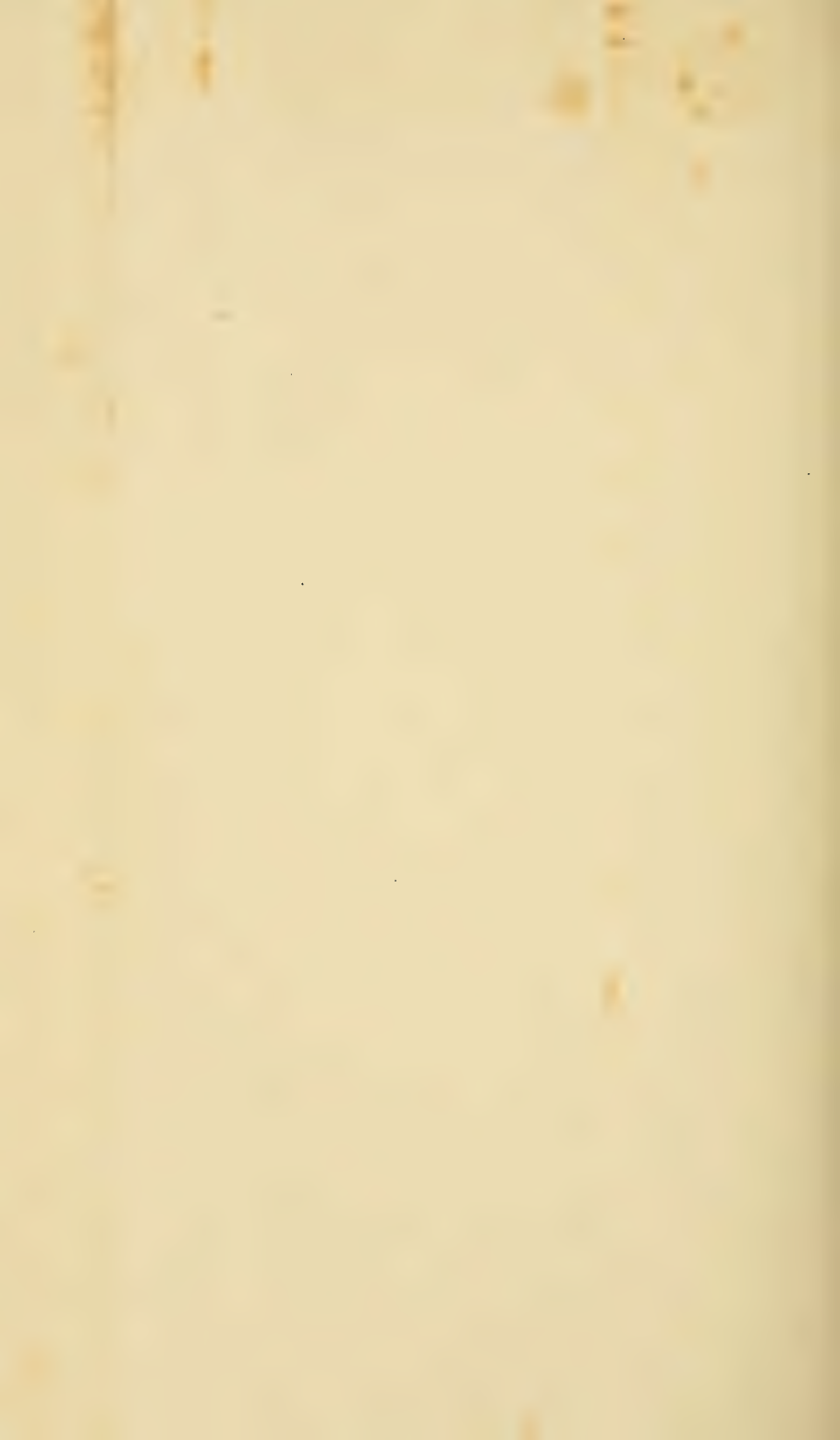
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HELICHRYSUM TESSELATUM, JHM et R.T.B



R.T. Baker, del.

1 to 6 EUCALYPTUS CORIACEA, 7 to 9 E. STELLULATA.







P.T.B. del

EUCALYPTUS

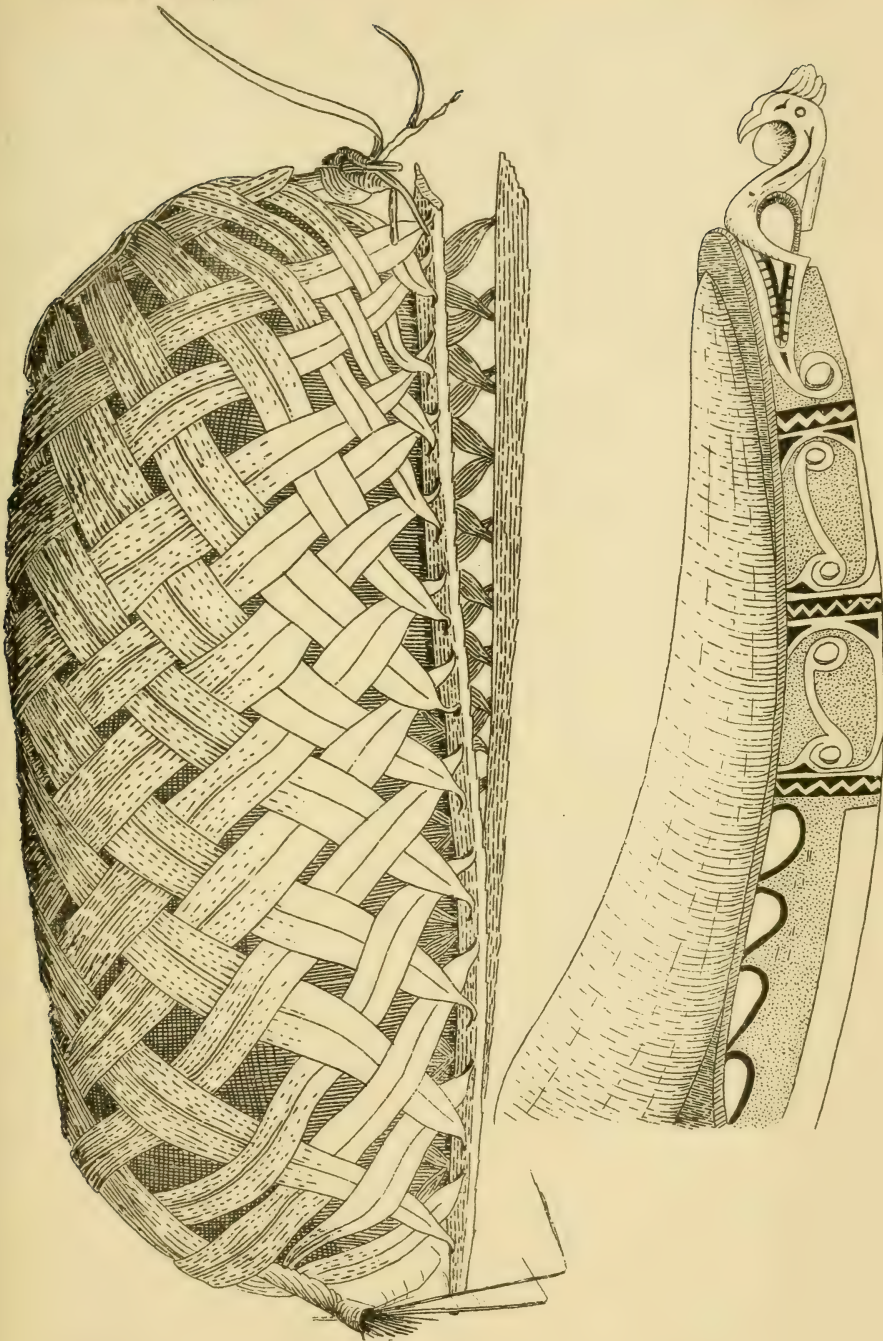
AMYGDALINA
LABILL. VAR. RADIATA.



R.T.B. del.

EUCALYPTUS AMYGDALINA,

LABILL. VAR. CATIFOLIA.



PROCEEDINGS
OF THE
LINNEAN SOCIETY
OF
NEW SOUTH WALES.

SUPPLEMENT TO VOL. X. (2ND SERIES), 1895.

CATALOGUE OF THE DESCRIBED COLEOPTERA OF
AUSTRALIA. SUPPLEMENT, PART I. *CICINDE-
LIDÆ* AND *CARABIDÆ*.*

BY GEORGE MASTERS.

Family *CICINDELIDÆ*.

Sub-Family *MEGACEPHALIDES*.

MEGACEPHALA, Latreille.

7203. FRENCH, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, viii.
1893, p. 25.

Queensland; Cloncurry River: also N.W. Aust.

TETRACHA, Hope.

7204. HELMSI, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 16.
W. Australia; Murchison District.

* The First Part of the Catalogue, to which the present Part is the First Supplement, is contained in Vol. x. p. 359 (published December 21st, 1885).

Sub-Family CICINDELIDES.

CICINDELA, Linné.

7205. *ALBOLINEATA*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 444.
N.W. Aust.; King's Sound.
7206. *CRASSICORNIS*, Macl., l.c. p. 445.
N.W. Aust.; King's Sound.
7207. *FROGGATTI*, Macl., l.c. ii. 1887, p. 213.
Queensland; from Rockhampton to Cape York: also
N.W. Aust.
7208. *OBLONGICOLLIS*, Macl., l.c. iii. 1888, p. 445.
N.W. Aust.; King's Sound.
7209. *TENUICOLLIS*, Macl., l.c. p. 446.
N.W. Aust.; King's Sound.
7210. *TRIVITTATA*, Macl., l.c. p. 444.
N.W. Aust.; King's Sound.
7211. *SAETIGERA*, Horn, Deutsche Ent. Zeitschr. 1893, p. 198.

DYSTYPSIDERA, Westwood.

7212. *FLAVIPES*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 214.
Queensland; Cairns District.
7213. *PARVA*, Macl., l.c. p. 215.
Queensland; Cairns District.
7214. *PASCOEI*, Macl., l.c. p. 215.
Queensland; Cairns District.
- Sp. 26. *D. GRUTI*, Pasc. = *Plustchevskyi*, Dok. = *fasciata*,
Motsch. = *volitans*, Macl.; Horn, Deutsche Ent. Zeitschr.
1892, p. 93.

Family CARABIDÆ.

Sub-Family CARABIDES.

CALOSOMA, Latreille.

- Sp. 35. *C. SCHAYERI*, Erich. = *C. grandipenne*, Castln.
Mr. Sloane has examined the type of *C. grandipenne*, and
is certain of their identity.

Sub-Family PAMBORIDES.

PAMBORUS, Latreille.

7215. *OPACUS*, Gehin, Cat. 1885, p. 79.
Australia.

LACORDAIRIA, Castelnau.

7216. *TERRENA*, Olliff, Proc. Linn. Soc. N.S. Wales, x. 1885, p. 467.
N.S. Wales; Mount Kosciusko.

Sub-Family ODACANTHIDES.

CASONIA, Latreille.

7217. *GLOBULICOLLIS*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2,
iii. 1888, p. 447.
N.W. Australia; King's Sound.
7218. *RIVERINÆ*, Sloane, l.c. v. 1890, p. 643.
N.S. Wales; Mulwala.

- Sp. 53. *C. ALIENA*, Pasc. = *C. australis*, Chaud. = *Clarensii*,
Casteln; Chaud., Bull. Mosc. xlv. 1872, p. 405; = *angus-*
ticollis, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 446; Sloane, l.c. v. 1890, p. 644.

EUDALIA, Castelnau.

7219. *FROGGATTI*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 448.
N.W. Aust.; King's Sound.

7220. *SUBLÆVIS*, Macl., l.c. p. 448.

N.W. Aust.; King's Sound.

Sp. 62. *E. WATERHOUSEI*, Casteln.; Macl., l.c. p. 447.

N.W. Aust.; King's Sound.

Sub-Family GALERITIDES.

ZUPHIUM, Latreille.

7221. *FITZROYENSE*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 449.

N.W. Aust.; King's Sound.

7222. *PINDAN*, Macl., l.c. p. 448.

N.W. Aust.; King's Sound.

Genus *DIAPHORUS*, Dej. = *Zuphiosoma*, Casteln.
Chaud., Bull. Mosc. lii. 1877, p. 252.

Sub-Family HELLUONIDES.

GIGADEMA, Thomson.

7223. *ATRUM*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 217.

Queensland; Cairns District.

7224. *EREMITA*, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 17.
Fraser Range.

7225. *FROGGATTI*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 449.

N.W. Aust.; King's Sound.

7226. *MANDIBULARE*, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 18.

Interior; Everard Range.

Sp. 88. *G. UNICOLOR*, Hope = Sp. 83, *G. minuta*, Casteln.;
Gestro, Ann. Mus. Genov. vii. 1875, p. 881.

ÆNIGMA, Newman.

- Sp. 77. *Æ. SPLENDENS*, Casteln. = Sp. 75. *Æ. Newmani*,
Casteln.; Gestro, Ann. Mus. Genov. vii. 1875, p. 873.

HELLUONIDIUS, Chaudoir.

- For species 91 and 92, *HELLUOSOMA CYANEUM*, Casteln.,
and *H. CYANIPENNE*, Hope; Chaud., Rev. Mag. Zool. 1872,
p. 21.

DICRANOGLOSSUS, Chaudoir.

- For species 94. *D. (HELLUOSOMA) RESPLENDENS*, Casteln.;
Chaud., Rev. Mag. Zool. 1872, p. 22.

HELLUOSOMA, Castelnau.

7227. *LATIPENNE*, MacL., Proc. Linn. Soc. N.S. Wales, ser. 2, ii.
1887, p. 217.

Queensland; Cairns District.

7228. *LONGICOLLE*, MacL., l.c. iii. 1888, p. 450.

N.W. Aust.; King's Sound.

7229. *VIRIDIPENNE*, MacL., l.c. ii. 1887, p. 214.

Queensland; Cairns District.

ACROGENYS, Macleay.

7230. *AUSTRALIS*, Blackb., Trans. Roy. Soc. S. Aust. xii. 1889,
p. 132.

S. Australia.

HELLUO, Bonelli.

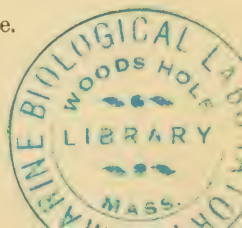
7231. *INSIGNIS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, v.
1890, p. 642.

N.S. Wales; Darling River.

LESTIANTHUS, Sloane.

7232. *SCULPTURATUS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2,
ix. 1894, p. 452.

N.S. Wales; Rope's Creek : Victoria; Lillydale.



Sub-Family BRACHINIDES.

PHEROPSOPHUS, Solier.

7233. MACLEAYI, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, ix.
1894, p. 453.
N.W. Aust.; King's Sound.

Sub-Family CALLIDIDES.

TRIGONOTHOPS, Macleay.

7234. CURTULA (CYMINDIS), Erichs., Wieg. Arch. 1842, i. p. 125
= *A. corticalis*, Chaud.; Blackb., Proc. Linn. Soc. N.S.
Wales, ser. 2, vii. 1892, p. 81.
S. Aust.; W. Aust.; Victoria.
7235. FASCIATA, Macl., l.c. iii. 1888, p. 451.
N.W. Aust.; King's Sound.
7236. ORNATA, Macl., l.c. p. 452.
N.W. Aust.; King's Sound.
7237. PALLIDIOR, Macl., l.c. p. 451.
N.W. Aust.; King's Sound.
- Sp. 104. T. FLAVOFASCIATA, Chd.; Blackb., Trans. Roy. Soc.
S. Aust. xiii. 1890, p. 82.
S. Australia.
- Sp. 105. T. LINEATA, Dej. = *T. plagiata*, Germ.; Blackb.,
Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892, p. 66.
S. Aust.; W. Aust.; Tasmania; N.S. Wales.
- Sp. 141. T. (DROMIUS) TRIDENS, Newm. = *T. pacifica*, Erichs.;
Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892, p.
67-75.
Widely distributed.
- Sp. 106. T. LONGIPLAGA, Chd.; Blackb., l.c. p. 65.
Victoria.

XANTHOPHŒA, Chaudoir.

7238. *FILIFORMIS*, Blackb., Trans. Roy. Soc. S. Aust. xvii. 1893
p. 294.

S. Australia; Goat Island, off Goolwa.

7239. *LOWERI*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, v.
1890, p. 304.

S. Australia.

7240. *PALLIDA*, Olliff, l.c. x. 1885, p. 468.

Australia (widely distributed).

7241. *SATELLES*, Blackb., Trans. Roy. Soc. S. Aust. xviii. 1893,
p. 294.

S. Australia; Eyre's Peninsula.

7242. *VARIABILIS*, MacL., Proc. Linn. Soc. N.S. Wales, ser. 2, iii,
1888, p. 452.

N.W. Aust.; King's Sound.

PLAGIOTELUM, Solier.

7243. *OPADESCENS*, Olliff, Proc. Linn. Soc. N.S. Wales, x. 1885,
p. 469.

Tasmania; Mount Wellington.

PHLŒOCARABUS, Macleay.

7244. *UMBRATUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv.
1889, p. 709.

S. Australia; Adelaide District.

7245. *UNIMACULATUS*, Blackb., l.c. p. 708.

S. Australia; Adelaide District.

- Sp. 139. *P.(DROMIUS) CRUELIS*, Newm.; Blackb., l.c. p. 710.

S. and W. Australia.

DIABATICUS, H. W. Bates.

7246. *MINOR*, Blackb., Trans. Roy. Soc. S. Aust. xii. 1889, p. 134.

S. Australia; Port Lincoln.

7247. *TUMIDICEPS*, Blackb., l.c. p. 135.

S. Australia; Port Lincoln.

LITHOTROTUS, Blackburn.

7248. *CÆRULESCENS*, Blackb., Trans. Roy. Soc. S. Aust. xviii. 1894,
p. 200.

Victoria; Alpine District.

Sub-Family *DROMIIDES*.

HOMOTHES, Newman.

7249. *ANGULATUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii.
1892, p. 68.

S. Australia; Port Lincoln District.

7250. *GRACILIS*, Blackb., l.c. p. 69.

S. Australia; MacDonnell Ranges.

7251. *PARVICOLLIS*, Blackb., l.c. p. 69.

N.S. Wales; near Sydney.

7252. *ROTUNDATUS*, Blackb., l.c. p. 70.

N.S. Wales; Blue Mountains.

DEMETRIUS, Bonelli.

7253. *RUFESCENS*, MacI., Proc. Linn. Soc. N.S. Wales, ser. 2, ii.
1887, p. 217.

Queensland; Cairns District.

7254. *TWEEDENSIS*, Blackb., l.c. vii. 1892, p. 67.

N.S. Wales; Tweed River.

DROMIUS, Bonelli.

7255. *YARRÆ*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii.
1892, p. 71.

Victoria; Upper Yarra.

Sub-Family LEBIIDES.

SAROTHROCREPIS, Chaudoir.

7256. DIMIDIATA, MacL., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 453.

N.W. Aust.; King's Sound.

7257. LITURATA, MacL., l.c. p. 453.

N.W. Aust.; King's Sound.

7258. NOTABILIS, MacL., l.c. p. 454.

N.W. Aust.; King's Sound.

7259. NOTATA, MacL., l.c. p. 453.

N.W. Aust.; King's Sound.

7260. SUAVIS, Blackb., l.c. iv. 1889, p. 711.

S. Australia; Port Lincoln.

- Sp. 149. *S. (LEBIA) CALIDA*, Newm.; Blackb., l.c. vii 1892.
p. 72.

Victoria.

- Sp. 157. *S. POSTICALIS*, Guér.; Blackb., l.c. p. 71.

S. Australia: Victoria: Tasmania.

- Sp. 152. *S. Duponti*, Putz., syn. of *S. BENEFICA*, Newm.;
Chaud. Bull. Mosc. 1846, p. 393; Blackb., l.c. p. 73.

TAROMORPHA, Blackburn.

7261. ALTERNATA, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
ix. 1894, p. 85.

N. Queensland.

ECTROMA, Blackburn.

7262. INQUINITA (*LEBIA*), Erich., Wieg. Arch. 1842, i. p. 125;
Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv. 1889,
p. 710.

Tasmania.

7263. OBSOLETUM, Blackb., l.c. vii. 1892, p. 72.
N.S. Wales; Blue Mountains.
7264. PARVICOLLE, Blackb., Trans. Roy. Soc. S. Aust. xviii. 1894,
p. 201.
W. Australia.
- Sp. 141. E. (DROMIUS) TRIDENS, Newm.; Blackb., Proc. Linn.
Soc. N.S. Wales, ser. 2, iv. 1889, p. 710.
- Sp. 148. E. (LEBIA) BENEFICA, Newm.; Blackb., l.c. p. 711.
- Sp. 150. E. (LEBIA) CIVICA, Newm.; Blackb., l.c. p. 711.

Sub-Family COPTODERIDES.

PHILOPHLÆUS, Chaudoir.

7265. CONFERTUS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
vii. 1892, p. 78.
W. Australia; Yilgarn.
7266. EUCALYPTI, Germ., var. *tasmaniae*, Blackb., l.c. p. 78.
Tasmania.
7267. FROGGATTI, Macl., l.c. iii. 1888, p. 455.
N.W. Aust.; King's Sound.
7268. LATICOLLIS, Blackb., l.c. vii. 1892, p. 77.
Victoria; Alpine District.
7269. MONTICOLA, Blackb., l.c. p. 75.
Victoria; Alpine District.
7270. OCCIDENTALIS, Blackb., l.c. v. 1890, p. 553.
W. Australia; Yilgarn.
7271. OPACICEPS, Blackb., l.c. iv. 1889, p. 714; l.c. vii. 1892, p. 78.
S. and W. Australia.
7272. ORNATUS, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 19.
Victoria Desert.
7273. PYGMÆUS, Blackb., l.c. p. 19.
Central Australia; Fraser Range.

7274. SYDNEYENSIS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892, p. 76.

N.S. Wales; Blue Mountains.

Sp. 164. *P. EUCALYPTI*, Germ.; Blackb., l.c. iv. 1889, p. 712.

Sp. 165. *P. FUSCIPENNIS*, Germ.; Blackb., l.c. p. 714.

Sp. 174. *P. (LEBIA) PLANA*, Newm.; Blackb., l.c. p. 714.

Sp. 169. *P. (LEBIA) IRRITUS*, Newm.; Blackb., l.c. vii. 1892, p. 80.

AGONOCHILA, Chaudoir.

7275. FENESTRATA, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892, p. 80.

Victoria: S. and W. Australia.

7276. PERPLEXA, Blackb., Trans. Roy. Soc. S. Aust. xviii. 1894, p. 201.

Victoria.

Sp. 184. *A. CRIBRIPENNIS*, Chaud.; Blackb., l.c. iv. 1889, p. 714.

Sp. 183. *A. CORTICALIS*, Chaud., syn. of *A. (Cymindis) curtula*, Erichs.; Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892, p. 81.

Sub-Family THYREOPTERIDES.

CATASCOPUS, Kirby.

7277. CHALYDICUS, Olliff, Proc. Linn. Soc. N.S. Wales, x. 1885, p. 470.

N.S. Wales; Richmond River.

SCOPODES, Erichson.

7278. FASCIOLATUS, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 219.

Queensland; Cairns District.

7279. FLAVIPES, Blackb., Trans. Roy. Soc. S. Aust. xviii. 1894, p. 202.

S. Australia.

7280. *INTERMEDIUS*, Blackb., l.c. p. 202.
Tasmania.
7281. *RUGATUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, ix.
1894, p. 85.
Central Australia; Oodnadatta.
7282. *SEXFOVEATUS*, Macl., l.c. iii. 1888, p. 456.
N.W. Aust.; King's Sound.
7283. *SIMPLEX*, Blackb., Trans. Roy. Soc. S. Aust. xviii. 1894,
p. 201.
Victoria; Alpine Ranges.

Sub-Family PSEUDOMORPHIDES.

SILPHOMORPHA, Westwood.

7284. *BIVITTATA*, Gestro, Ann. Mus. Civ. Genov. xx. 1884, p. 302.
Australia.
7285. *BOOPS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 807.
N. Territory of S. Aust.
7286. *CENTRALIS*, Macl., l.c. p. 458.
N.W. Aust.; King's Sound.
7287. *CORDIFER*, Blackb., l.c. ix. 1894, p. 86.
Queensland; Cairns District.
7288. *FLAVICOLLIS*, Macl., l.c. iii. 1888, p. 458.
N.W. Aust.; King's Sound.
7289. *FROGGATTI*, Macl., l.c. p. 457.
N.W. Aust.
7290. *FUGAX*, Westw., Rev. Mag. Zool. ser. 2, v. 1853, p. 398; =
Sp. 240. *S. polita*, Macl.; Gestro, Ann. Mus. Civ. Genov.
xx. 1884, p. 303.

7291. *LATICOLLIS*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 457.
N.W. Aust.; King's Sound.
7292. *MACLEAYI*, Masters, (*bivittata*, Macl.) Macl., l.c. p. 459
(nom. præocc).
N.W. Aust.; King's Sound.
7293. *OBSOLETA*, Macl., l.c. p. 457.
N.W. Aust.; King's Sound.
7294. *ORNATA*, Macl., l.c. p. 458.
N.W. Aust.; King's Sound.
7295. *PUNCTATISSIMA*, Macl., l.c. p. 457.
N.W. Aust.; King's Sound.
7296. *RUFOGUTTATA*, Blackb., Trans. Roy. Soc. S. Aust. xvii.
1892-3, p. 295.
N. Queensland.
7297. *SPRETA*, Blackb., Proc. Linn. Soc. N S. Wales, ser. 2, iii.
1888, p. 805.
N. Territory of S. Aust.
7298. *STRIATIPENNIS*, Macl., l.c. p. 456.
N.W. Aust.; King's Sound.
- Sp. 214. *S. AMABILIS*, Casteln.; Blackb., l.c. iv. 1889, p. 1247.
- Sp. 216. *S. BIMACULATA*, Casteln. = *B. biplagiata*, Casteln.;
Gestro, Ann. Mus. Civ. Genov. xx. 1884, p. 303.
- Sp. 233. *S. MACULIGERA*, Macl. = *S. brisbanensis*, Casteln.;
Gestro, l.c. p. 302.
- Sp. 232. *S. MACULATA*, Newm. = *S. quadrisignata*, Casteln.;
Gestro, l.c. p. 302.
- Sp. 248. *S. SUTURALIS*, Germ. = *S. rufomarginata*, Macl.;
Gestro, l.c. p. 303.

ADELOTOPUS, Hope.

7299. *BREVIPENNIS*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.,
1888, p. 459.
N.W. Aust.; King's Sound.

7300. *ELONGATULUS*, Macl., l.c. p. 459.
N.W. Aust.; King's Sound.

7301. *LÆVIS*, Macl., l.c. p. 460.
N.W. Aust.; King's Sound.

7302. *LINEARIS*, Macl., l.c. p. 460.
N.W. Aust.; King's Sound.

7303. *LONGIPENNIS*, Macl., l.c. p. 459.
N.W. Aust.; King's Sound.

Sp. 266. *A. GYRINOIDES*, Hope = *A. paroensis*, Casteln.;
Gestro, Ann. Mus. Civ. Genov. xx. 1884, p. 303.

Sp. 273. *A. OBSCURUS*, Casteln. = *A. subopacus*, Macl.;
Gestro, l.c. p. 303.

Sub-Family MORIONIDES.

MORIO, Latreille.

Sp. 292. *M. NOVÆ-HOLLANDIÆ*, Casteln. = *M. australasiæ*,
Chaud.; Chaud., Bull. Mosc. lv. 1880, p. 361.

MORIOMORPHA, Castelnau.

7304. *ADELAIDÆ*, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 124.
S. Australia.

7305. *VICTORIÆ*, Casteln., l.c. p. 124.
Victoria; Dandenong Ranges.

TERAPHIS, Castelnau.

7306. *HELSI* (*DRIMOSTOMA*), Sloane, Proc. Linn. Soc. N.S. Wales,
ser. 2, v. 1890, p. 647.
N.S. Wales; Richmond River.

LACCOCENUS, Sloane.

7307. *AMBIGUUS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, v.
1890, p. 646.
N.S. Wales; Richmond River.

Sub-Family MYSTROPOMINI.

Gen. MYSTROPOMUS removed from the OZENIDES and formed into a separate sub-fam. MYSTROPOMINI, Horn, Trans. Am. Ent. Soc. ix.

Sub-Family SCARITIDES.

NEOSCAPHUS, Sloane.

7308. SIMPLEX, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 1120.

N.S. Wales; Mulwala.

CONOPTERUM, Chaudoir.

7309. BARNARDI, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 127.

Queensland; Dawson River.

7310. BICORNUTUM, Macl., l.c. p. 128.

N. Queensland; Endeavour River.

7311. INCORNUTUM, Macl., l.c. p. 129.

N.S. Wales; Richmond River.

7312. LITTORALE, Macl., l.c. p. 128.

N.S. Wales; Richmond River.

7313. MODESTUM, Sloane, l.c. iii. 1888, p. 1119.

W. Aust.; Nicol Bay.

7314. VIOLACEUM, Macl., l.c. ii. 1887, p. 127.

N.S. Wales; Mudgee District.

Sp. 402. C. (CARENUM) RIVERINÆ, Macl., l.c. p. 118 = Sp. 310. *C. amabile*, Casteln.; Sloane, l.c. vii. 1893, p. 482.

CARENIDIUM, Chaudoir.

7315. CHAUDOIRI, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 125.

N. Queensland; Endeavour River.

7316. DARLINGENSE, Macl., l.c. p. 124.

N.S. Wales; Bourke District.

7317. SEPTENTRIONALE, Macl., l.c. p. 126.

Queensland; Peak Downs.

7318. TROPICALE, Macl., l.c. p. 127.

N. Queensland; Endeavour River.

- Sp. 313. C. DAMELI, Macl.; Macl., l.c. p. 125.

- Sp. 312. C. (CARENUM) SUPERBUM, Casteln.; Sloane, l.c. viii.
1893, p. 481.

- Sp. 420. C. SUPERBUM, Casteln. = *C. Kreuzleræ*, Macl., and
C. lacustre, Macl.; Sloane, l.c. p. 481.

- Sp. 377. C. (CARENUM) MUCRONATUM, Macl.; Macl., l.c. ii.
1887, p. 118.

TRICHOCARENUM, Blackburn.

7319. ELDERI, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 21.
Central Australia; Victoria Desert.

EUTOMA, Newman.

7320. ADELAIDÆ, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 131.
S. Australia; Ashton.

7321. BREVIPENNE, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii.
1887, p. 131.

Queensland; Moreton Bay.

7322. FRENCHI, Sloane, l.c. viii. 1893, p. 476.

N. Queensland.

7323. MAGNIFICUM, Macl., l.c. ii. 1887, p. 130.

Queensland; Peak Downs.

7324. PUNCTULATUM, Macl., l.c. p. 130.

Queensland; Dawson River.

7325. VIRIDICOLOR, Sloane, l.c. ix. 1894, p. 402.

N. Territory of S. Australia.

Sp 319. *E. BIPUNCTATUM*, Macl. = *E. loddonense*, Casteln.
= *Newmani*, Castln. = *E. punctulatum*, Macl.; Sloane,
l.c. viii. 1893, p. 475.

Sp. 417. *CARENUM SUBRUGOSULUM*, Macl. }
Sp. 418. *CARENUM SUBSTRIATULUM*, Macl. } put in EUTOMA.
Sp. 423. *CARENUM UNDULATUM*, Macl.;
Macl., l.c. ii. 1887, p. 119.

CARENOSCAPHUS, Macleay.

7326. *LUCIDUS*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, 1887,
p. 131.

Queensland; Dawson River.

7327. *VIRIDISSIMUS*, Macl., l.c. iii. 1888, p. 460.

N.W. Aust.; King's Sound.

PALISCAPHUS, Sloane.

7328. *FELIX*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888,
p. 1118.

N.S. Wales; Darling River.

CARENUM, Bonelli.

7329. *ARENARIUM*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 1114.

N.S. Wales; Mulwala.

7330. *BREVICOLLE*, Sloane, l.c. viii. 1893, p. 467.

Nullabar Plains; Eucla District.

7331. *CASTELNAUI*, Chaud., Ann. Soc. Ent. Belg. xi. 1867-8, 141.
Victoria.

7332. *COGNATUM*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, ix.
1894, p. 400.

Queensland; Darling Downs.

7333. *CONVEXUM*, Chaud., Ann. Soc. Ent. Belg. xi. 1867-8, 142.

N. Australia.

7334. *CUPREO-MARGINATUM*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 63.
S. Aust.; Fowler's Bay.
7335. *DECORUM*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 1115.
N.S. Wales; Coonamble.
7336. *FRENCH*, Sloane, l.c. ix. 1894, p. 396.
W. Aust.; Gnarlbine.
7337. *FUGITIVUM*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 61.
S. Aust.; Wallaroo.
7338. *GAWLERENSE*, Casteln., Trans. Roy. Soc. Vict. viii. 1868, p. 138; Macl., Trans. Ent. Soc. N.S. Wales, ii. 1869, p. 59; Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, viii. 1893, p. 466.
S. Aust.; Gawler.
7339. *GRACILE*, Sloane, l.c. ix. 1894, p. 401.
Lower Murray.
7340. *HABILE*, Sloane, l.c. vi. 1891, p. 428.
W. Aust.; between York and Yilgarn.
7341. *INCONSPICUUM*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 59.
S. Aust.; Fowler's Bay.
7342. *IGNOTUM*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, vi. 1891, p. 427.
W. Aust.; between York and Yilgarn.
7343. *IRIDESCENS*, Sloane, l.c. viii. 1893, p. 470.
Interior of S. Aust.
7344. *LÆVICOLLE*, Sloane, l.c. iii. 1888, p. 1116.
Queensland; Johnstone River.
7345. *LEPIDUM*, Sloane, l.c. iv. 1889, p. 1291.
S. Aust.; Fowler's Bay.

7346. MACLEAYI, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 64.
S. Aust.; Wallaroo.
7347. OBSOLETUM, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii.
1887, p. 192.
Queensland; Dawson River.
7348. OPTIMUM, Sloane, l.c. ix. 1894, p. 397.
W. Aust.; Murchison District.
7349. PURPUREO-MARGINATUM, Macl., l.c. ii. 1887, p. 132.
N.S. Wales; Coonabarabran.
7350. RUGATUM, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 62.
S. Aust.; Fowler's Bay.
7351. SPLENDENS, Casteln., Trans. Roy. Soc. Vict. viii. 1868,
p. 136.
Queensland; Port Denison.
7352. TIBIALE, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, viii.
1893, p. 468.
Central Aust.; MacDonnell Ranges.
7353. VICINUM, Sloane, l.c. iv. 1889, p. 1293.
S. Aust.; Fowler's Bay.
7354. VIRESCENS, Sloane, l.c. viii. 1893, p. 471.
W. Aust.; Murchison River District.
- Sp. 406. *C. SEXPUNCTATUM*, Macl. = *C. arenarium*, Sloane;
Sloane, l.c. viii. 1893, p. 474.
- Sp. 371. *C. INTERRUPTUM*, Macl. = *C. Castelnaui*, Chaud.;
= *C. occultum*, Macl.; Sloane, l.c. p. 473.
- Sp. 366. *C. ELEGANS*, Macl. = *C. campestre*, Macl.; Sloane,
l.c. ix. 1894, p. 399.
- Sp. 386. *C. ODEWAHNI*, Casteln. = *C. ordinatum*, Macl.;
Sloane, l.c. vi. 1891, p. 430.
- Sp. 350. *C. BONELLI*, Brullé = *C. scitulum*, Macl. = *viridi-*
penne, Westw. = *Westwoodi*, Casteln.; Sloane, l.c. p. 430.

Sp. 374. *C. LÆVIPENNE*, Macl. = *C. lavicolle*, Sloane; Sloane, l.c. viii. 1893, p. 468.

Sp. 419. *C. SUMPTUOSUM*, Westw.; Blackb., l.c. iv. 1889, p. 445.

PLATYTHORAX, Chaudoir.

7355. *INTERIORIS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2. iii. 1888, p. 1113.

N.S. Wales; Wilcannia.

7356. *TRANSVERSICOLLE*, Chaud., Ann. Soc. Ent. Belg. xi. 1867-8, p. 139; Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv. 1889, p. 716.

Australia.

LACCOPTERUM, Macleay.

7357. *FOVEIGERUM (CARENUM)*, Chaud., Ann. Soc. Ent. Belg. xi. 1867-8, p. 138.

N. Queensland; Cape York.

7358. *LACUNOSUM*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 132.

N.S. Wales; Coonabarabran.

7359. *LOCULOSUM (CARENUM)*, Newm., The Entomol. p. 369 = *L. variolosum*, Macl.; Sloane, l.c. vi. 1891, p. 430.

Victoria and N.S. Wales.

Sp. 362. *L. (CARENUM) DIGGLESII*, Macl.; Sloane, l.c. viii. 1893, p. 461.

EPILECTUS, Blackburn.

7360. *FORTIS (EURYGNATHUS)*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 13; l.c. p. 177.

S. Aust.; Ardrossan.

PHILOSCAPHUS, Macleay.

7361. *BARNARDI*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 973.

Queensland; Dawson River.

7362. CRASSUS, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 37.
S. Australia.
7363. DUBOULAYI, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
v. 1890, p. 554.
N. Queensland.
7364. TEPPERI, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 36.
S. Australia; Angebuckina.
- EURYSCAPHUS, Macleay.
7365. ATRATUS, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, viii.
1893, p. 456.
Queensland; Burketown District.
7366. CHAUDOIRI, Blackb., l.c. vii. 1892, p. 82.
S. Aust.; near Morgan.
7367. CONCOLOR, Sloane, l.c. viii. 1893, p. 459.
S. Aust.; Fowler's Bay.
7368. EBENINUS, Sloane, l.c. v. 1890, p. 641.
W. Aust.; Yilgarn.
7369. POLITUS, Sloane, l.c. viii. 1893, p. 457.
Central Aust.; MacDonnell Ranges.
7370. TATEI, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 1.
S. Aust.; Ouldea.
7371. TERRENUS, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, ix.
1894, p. 394.
W. Aust.; Murchison District.
7372. SUBSULCATUS, Blackb., Trans. Roy. Soc. S. Aust. x. 1887,
p. 2.
S. Aust.; Ouldea.
7373. SULCICOLLIS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
vii. 1892, p. 81.
S. Aust.; Basin of Lake Eyre.

Sp. 450. *E. WATERHOUSEI*, Macl. = *E. titanus*, Sloane, l.c. iv. 1889, p. 1288; l.c. viii. 1893, p. 455.

Central Aust.; MacDonnell Ranges.

Sp. 448. *E. MINOR*, Macl. = *E. arenarius*, Sloane, l.c. iii. 1888, p. 1108; l.c. v. 1890, p. 642. = *E. affinis*, Casteln.; Sloane, l.c. viii. 1893, p. 457.

Sp. 449. *E. OBESUS*, Macl. = *E. ferox*, Sloane, l.c. iii. 1888, p. 1109; l.c. v. 1890, p. 642. = *E. bipunctatus*, Macl. = *E. Howitti*, Casteln.; Sloane, l.c. viii. 1893, p. 460.

CALLISCAPTERUS, Macleay.

7374. *FOVEOLATUS*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 462.

N.W. Aust.; King's Sound.

7375. *HABITANS*, Sloane, l.c. iv. 1889, p. 1290.

Central Aust.; MacDonnell Ranges.

7376. *SPECIOSUS*, Sloane, l.c. iii. 1888, p. 1110.

W. Aust.; Gascoigne River.

7377. *VIRIDIENEUS*, Macl., l.c. p. 461.

N.W. Aust.; King's Sound.

SCARAPHITES, Westwood.

7378. *ASSIMILIS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, viii. 1893, p. 452.

S. Aust.; Fowler's Bay.

7379. *INSULANUS*, Sloane, l.c. iii. 1888, p. 1106.

Victoria; King's Island.

7380. *OPULENS* (*CHARISCAPTERUS*), Sloane, l.c. viii. 1893, p. 452.

W. Aust.; Eucla.

7381. *PACIFICUS*, Sloane, l.c. p. 1107.

W. Aust.; Eucla.

Sp. 452. *S. CRENATICOLLIS*, Macl. = *S. hirtipes*, Macl.; Sloane, l.c. viii. 1893, p. 453.

GEOSCAPTUS, Chaudoir.

7382. DAMASTES, MacL., Trans. Ent. Soc. N.S. Wales, i. 1863, p. 68.

N.S. Wales; Murrumbidgee.

7383. CRASSUS, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, ix. 1895, p. 393.

N. Queensland; Cooktown District.

STEGANOMMA, Macleay.

7384. PORCATUM, MacL., Proc. Linn. Soc. N.S. Wales, ser. 2, ii. 1887, p. 133.

N. Queensland; Cairns.

DYSCHIRIUS, Bonelli.

7385. OVENSSENSIS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 775.

Victoria; Ovens River.

7386. TORRENSSENSIS, Blackb., Trans. Roy. Soc. S. Aust. xiii. 1890, p. 82.

S. Australia; Torrens River.

SCOLYPTUS, Putzeys.

7387. OBSCURIPENNIS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv. 1889, p. 1247.

N. Territory of S. Australia.

CLIVINA, Latreille.

7388. ADELAIDÆ, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv. 1889, p. 720.

S. Australia; Adelaide District.

7389. ÆQUALIS, Blackb., l.c. 718; l.c. vii. 1892, p. 83.

N. Territory of S. Australia.

7390. BOOPS, Blackb., l.c. iv. 1889, p. 719.

S. Australia; Port Lincoln.

7391. BOVILLÆ, Blackb., l.c. p. 717.
N. Territory of S. Australia.
7392. DEBILIS, Blackb., l.c. p. 722.
S. Australia; Port Lincoln.
7393. DORSALIS, Blackb., l.c. p. 719.
S. Australia; Port Lincoln.
7394. EREMICOLA, Blackb., l.c. ix. 1894, p. 86.
Central Australia; Oodnadatta.
7395. HELMSI, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 22.
S. Australia; Cootanoorina.
7396. OODNADATTÆ, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
ix. 1894, p. 86.
Central Australia; Oodnadatta.
7397. TUBERCULIFRONS, Blackb., l.c. p. 721.
Australia.
7398. WILDI, Blackb., l.c. iv. 1889, p. 721.
N. Territory of S. Australia.

Sub-Family PANAGEIDES.

EPICOSMUS, Chaudoir.

7399. NOBILIS (EUDEMA), Macl., Proc. Linn. Soc. N.S. Wales, ser.
2, iii. 1888, p. 462.
N.W. Aust.; King's Sound.
7400. PARVULUS (EUDEMA), Macl., l.c. p. 463.
N.W. Aust.; King's Sound.

Sub-Family CHLÆNIDES.

CHLÆNIUS, Bonelli.

7401. BINOTATUS, Dej., Spec. ii. p. 302 = *C. puncticeps*, Gem. and
Har. = *C. punctatus*, Chaud.; Chaud., Ann. Mus. Civ.
Genov. viii. 1876, p. 48.
Australia; widely distributed.

7402. LÆTEVIRIDIS, Chaud.=*C. darlingensis*, Casteln.=*C. marginatus*, Casteln.; Chaud., Ann. Mus. Civ. Genov. viii. 1876, p. 109.
7403. RUDICOLLIS, Chaud.=*C. bimaculatus*, Macl.; Chaud., l.c. p. 47.
- Sp. 548. C. OPHONOIDES, Fairm.=*C. peregrinus*, Laferti. Chaud., l.c. p. 72.

COPTOCARPUS, Chaudoir.

- Sp. 554. C. AUSTRALIS, Dej. = *C. (Oodes) fuscitarsis*, Blanch.; Chaud., Ann. Soc. Ent. Fr. (6), ii. 1882, p. 509.
- Sp. 557. C. (ODES) CONVEXUS, Casteln.; Chaud., l.c. p. 510.
- Sp. 563. C. (ODES) THORACICUS, Casteln.; Chaud., l.c. p. 512.

ODES, Bonelli.

7404. FITZROYENSIS, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 464.
N.W. Aust.; King's Sound.
7405. FROGGATTI, Macl., l.c. p. 463.
N.W. Aust.; King's Sound.
7406. LILLIPUTANUS, Macl., l.c. p. 464.
N.W. Aust.; King's Sound.
7407. PYGMÆUS, Macl., l.c. p. 464.
N.W. Aust.; King's Sound.
- Sp. 564. O. BOSTOCKI, Casteln.; Chaud., Ann. Soc. Ent. Fr. (6), ii. 1882, p. 367.
- Sp. 565. O. DENISONENSIS, Casteln.; Chaud., l.c. p. 363.
- Sp. 567. O. INORNATUS, Casteln. = *proximus*, Casteln. Chaud., l.c. p. 343.
- Sp. 570. O. LATUS, Casteln.; Chaud., l.c. p. 344.
- Sp. 571. O. MODESTUS, Casteln.; Chaud., l.c. p. 366.
- Sp. 572. O. OBLONGUS, Casteln.; Chaud., l.c. p. 360.

Sp. 576. *O. TRISULCATUS*, Casteln.; Chaud., l.c. p. 362.

Sp. 577. *O. WATERHOUSEI*, Casteln. = *interioris*, Casteln.;
Chaud., l.c. p. 364.

Sub-Family LICINIDES.

PHYSOLESTHUS, Chaudoir.

7408. *PALLIDUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv.
1889, p. 1250.

S. Aust.; Murray River.

Sub-Family CNEMACANTHIDES.

PROMECODERUS, Dejean.

7409. *AMBIGUUS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, vii.
1892, p. 49.

Northern Territory of S. Australia.

7410. *BLACKBURNI*, Sloane, l.c. v. 1890, p. 223.
S. Australia; Port Lincoln.

7411. *CASTELNAUI*, Sloane, l.c. vii. 1892, p. 46.
N.S. Wales; Narrabri, Wialda District.

7412. *COMES*, Sloane, l.c. v. 1890, p. 214.
N.S. Wales; Wallangarra.

7413. *CONCOLOR*, Germ., var. *NAMOYENSIS*, Sloane, l.c. vii. 1892, p.
48.
N.S. Wales; Narrabri, Gunnedah.

7414. *DISTINCTUS*, Sloane, l.c. v. 1890, p. 224.
W. Australia; Magadup.

7415. *INSIGNIS*, Sloane, l.c. p. 222.
N.S. Wales; Orange.

7416. *NIGELLUS*, Sloane, l.c. p. 211.
N.S. Wales; Dabee.

7417. *PACIFICUS*, Sloane, l.c. p. 206.
Victoria; Otway Ranges.

7418. *POLITUS*, Sloane, l.c. p. 218.

N.S. Wales; Lachlan River.

Sp. 606. *P. NEGLECTUS*, Casteln.; Putz., Revis. Ann. Mus. Civ. Genov. 1873, iv. p. 234.

P. puella, Putz., Stett. Ent. Zeit. 1868, p. 343; Sloane.

Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 195.

Sp. 596. *P. INORNATUS*, Macl.; Sloane, l.c. p. 196.

Sp. 612. *P. PUNCTICOLLIS*, Macl.; Sloane, l.c. p. 196.

Sp. 589. *P. DORSALIS*, Macl.; Sloane, l.c. p. 197.

Sp. 609. *P. OLIVACEUS*, Macl.; Sloane, l.c. p. 198.

Sp. 616. *P. SEMISTRIATUS*, Casteln.; Putz., Revis. 1873, p. 328; Sloane, l.c. p. 200.

Sp. 618. *P. SUBDEPRESSUS*, Guér.; Putz., Stett. Ent. Zeit. 1868, p. 344; Revis. 1873, p. 326; Sloane, l.c. p. 201.

Sp. 591. *P. ELEGANS*, Casteln.; Putz., Revis. 1873, p. 327; Sloane, l.c. p. 202.

Sp. 604. *P. MODESTUS*, Casteln.; Putz., Revis. 1873, p. 327; Sloane, l.c. p. 203.

Sp. 592. *P. GIBBOSUS*, Gray; Putz., Stett. Ent. Zeit. 1868, p. 337; Revis. 1873, p. 329; Sloane, l.c. p. 203.

Sp. 602. *P. MASTERSI*, Macl.; Sloane, l.c. p. 204.

Sp. 584. *P. BASSI*, Casteln.; Putz., Revis. 1873, p. 329; Sloane, l.c. p. 205.

Sp. 613. *P. PYGMÆUS*, Casteln.; Putz., Revis. p. 322; Sloane, l.c. p. 207.

Sp. 582. *P. ALBANIENSIS*, Casteln.; Putz., Stett. Ent. Zeit. 1868, p. 343; Revis. 1873, p. 326; Sloane, l.c. p. 208.

Sp. 601. *P. MARITIMUS*, Casteln.; Putz., Revis. 1873, p. 332; Sloane, l.c. p. 209.

Sp. 617. *P. STRIATO-PUNCTATUS*, Casteln.; Putz., Revis. p. 332; Sloane, l.c. p. 209.

Sp. 607. *P. NIGRICORNIS*, Casteln.; Putz., Revis. p. 331; Sloane, l.c. p. 210.

- Sp. 597. *P. INTERRUPTUS*, Macl.; Sloane, l.c. p. 212.
- Sp. 621. *P. WILCOXI*, Casteln.; Putz., Revis. p. 333; Sloane, l.c. p. 212.
- Sp. 595. *P. HUNTERIENSIS*, Macl.; Sloane, l.c. p. 213.
- Sp. 586. *P. CLIVINOIDES*, Guér.; Putz., Stett. Ent. Zeit. 1868, p. 341.
P. minutus, Casteln.; Sloane, l.c. p. 215.
- Sp. 590. *P. DYSCHIRIOIDES*, Guér.; Putz., Stett. Ent. Zeit. 1868, p. 342; Revis. 1873, p. 337; Sloane, l.c. p. 216.
- Sp. 615. *P. SCAUROIDES*, Casteln.; Putz., Revis. p. 336; Sloane, l.c. p. 217.
- Sp. 583. *P. ANTHRACINUS*, Macl.; Sloane, l.c. p. 219.
- Sp. 598. *P. LUCIDICOLLIS*, Casteln.; Putz., Revis. p. 335.
P. riverinæ, Macl. Sloane, l.c. p. 220.
- Sp. 594. *P. HOWITTI*, Casteln.; Putz. Revis. p. 335; Sloane, l.c. p. 220.
- Sp. 608. *P. OBLONGUS*, Casteln.; Putz., Revis. p. 334; Sloane, l.c. p. 221.
- Sp. 587. *P. CONCOLOR*, Germ.; Putz., Revis. p. 335 = *P. suturalis*, Casteln.; Putz., Stett. Ent. Zeit. 1868, p. 341; Revis. 1873, p. 335.
P. lucidus, Putz., Stett. Ent. Zeit. 1868, p. 339; Sloane, l.c. p. 221.
- Sp. 593. *P. GRACILIS*, Germ.; *Anheterus gracilis*, Putz., Stett. Ent. Zeit. 1868, p. 345.
P. parvulus, Macl.; Sloane, l.c. p. 225.

PARROA, Castelnau.

7419. *APICALIS*, Sloane, Trans. Roy. Soc. S. Aust. xvi. 1893, p. 210.
 Australia.
7420. *LÆVIGATA*, Sloane, l.c. p. 209.
 Central Australia; Barrow Range.
7421. *NOCTIS*, Sloane, l.c. p. 207.
 W. Australia; Murchison District.

ADOTELA, Castelnau.

7422. *ATRONITENS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 235.
S. Australia.
7423. *AUSTRALIS*, Sloane, l.c. p. 236.
S. Australia; Wallaroo.
7424. *FRENCHI*, Sloane, l.c. p. 240.
Roebuck Bay.
- Sp. 625. *A. (PARROA) HOWITTI*, Casteln.; Putz., Revis. 1873, p. 338; Sloane, l.c. v. 1890, p. 231.
- Sp. 623. *A. (PARROA) CARBONARIA*, Casteln.; Putz., Revis. p. 340; Sloane, l.c. p. 232.
- Sp. 627. *A. CARENOIDES*, Putz.; Putz., Revis. p. 341; Sloane, l.c. p. 232.
- Sp. 632. *A. (PROMECODERUS) VIRIDIS*, Macl.; Sloane, l.c. p. 233.
- Sp. 626. *A. (PARROA) VIOLACEA*, Casteln.; Putz., Revis. p. 340; Sloane, l.c. p. 233.
- Sp. 629. *A. ESMERALDA*, Casteln.; Putz., Revis. p. 340 : Sloane, l.c. p. 234; Trans. Roy. Soc. S. Aust. xvi. 1893, p. 212.
- Sp. 622. *A. (PARROA) BICOLOR*, Casteln.; Sloane, l.c. p. 234.
- Sp. 624. *A. (PARROA) GRANDIS*, Casteln.; Putz., Stett. Ent. Zeit. 1868, p. 350; Revis. p. 339 : Sloane, l.c. p. 237; Trans. Roy. Soc. S. Aust. xvi. 1893, p. 205.
- Sp. 628. *A. CONCOLOR*, Casteln.; Putz., Stett. Ent. Zeit. 1868, p. 348; Revis. p. 339; Sloane, l.c. p. 238.
- Sp. 630. *A. NIGERRIMA*, Macl.; Sloane, l.c. p. 239.
- Sp. 631. *A. STRIOLATA*, Putz.; Putz., Revis. p. 341; Sloane, l.c. p. 239.

CEROTALIS, Castelnau.

7425. *AMABILIS*, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 228.
Queensland; Duaringa.

- Sp. 633. C. (PROMECODERUS) SEMIVIOLOCEA, Casteln.; Putz., Stett. Ent. Zeit. 1868, p. 336; Revis. 1873, p. 325; Sloane, l.c. p. 226.
- Sp. 634. C. (PROMECODERUS) SUBSTRIATA, Casteln.; Putz., l.c. p. 335; Revis. p. 325; Sloane, l.c. p. 226.
- Sp. 600. C. MAJUSCULA, Putz.; Putz., l.c. p. 336; Revis. p. 325; Sloane, l.c. p. 227.
- Sp. 635. C. VERSICOLOR, Casteln.; Sloane, l.c. p. 227.

PERCOSOMA, Schaum.

7426. CARENOIDES, White, Voy. Ereb. Terr. 1846, p. 4, t. 1, f. 6
= *Hopei*, Sturm, Cat. 1843, p. 27; Sloane, Proc. Linn.
Soc. N.S. Wales, ser. 2, vii. 1892, p. 58.
Tasmania.

7427. CONCOLOR, Sloane, l.c. p. 61.

Victoria; Maryville District.

- Sp. 637. P. SULCIPENNE, Bates; Sloane, l.c. p. 62.
- Sp. 640. P. (MECODEMA) MONTANUM, Casteln.; Putz., Ann.
Mus. Civ. Genov. iv. 1873, p. 316; Sloane, l.c. p. 60.

LYCHNUS, Putzeys.

7428. ATER, Putz., Stett. Ent. Zeit. 1868, p. 325; = *strangulatus*,
Bates, Cist. Ent. ii. 1878, p. 317; Sloane, Proc. Linn.
Soc. N.S. Wales, ser. 2, vii. 1892, p. 57.
Tasmania.

7429. STRIATULUS, Bates, l.c. p. 318; Sloane, l.c. p. 58.
Central Tasmania.

EURYLICHNUS, Bates.

7430. OLLIFFI, Bates, Ent. Month. Mag. (2), ii. 1891, p. 286;
Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892,
p. 53.
N.S. Wales; Mount Kosciusko, Burrawang,

7431. VICTORIÆ, Sloane, l.c. p. 52.

Victoria; Melbourne District.

- Sp. 639. E. (MECODEMA) BLAGRAVEI, Casteln.; Putz., Stett.
Ent. Zeit. 1868, p. 233; Bates, Ent. Month. Mag. (2),
ii. 1891, p. 286; Sloane, l.c. p. 51.

PERCOLESTUS, Sloane.

7432. BLACKBURNI, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2,
vii. 1892, p. 55.

Victoria; Upper Ovens River.

Sub-Family STOMIDES.

DARODILIA, Castelnau.

7433. CASTELNAUI, Mael., Proc. Linn. Soc. N.S. Wales, ser. 2, iii.
1888, p. 465.

N.W. Aust.; King's Sound.

7434. MACILENTA, Sloane, l.c. ix. 1894, p. 444.

N.S. Wales; Darling River.

7435. RUGISTERNUS, Sloane, l.c. p. 445.

Queensland; Rockhampton District.

Sub-Family HARPALIDES.

PHORTICOSOMUS, Schaum.

7436. BRUNNEUS, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 178.
S. Australia; Lyndoch Valley.

7437. MUCRONATUS, Blackb., l.c. p. 178.

S. Australia; Sedan.

7438. RANDALLI, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
1889, p. 722.

N. Territory of S. Aust.

7439. ROBUSTUS, Blackb., Trans. Roy. Soc. S. Aust. xii. 1889,
p. 135.

S. Australia.

7440. SIMILIS, Blackb., l.c. x. 1887, p. 179

S. Australia.

ANISODACTYLUS, Dejean.

- Sp. 669. A. WATERHOUSEI, Casteln. = *A. (Harpalus) inferioris*, Casteln.; Chaud., Ann. Mus. Civ. Genov. xii. 1878, p. 513.

GNATHAPHANUS, W. S. Macleay.

7441. ARIDUS, Blackb., Trans. Roy. Soc. S. Aust. xvi. 1892, p. 22.
Central Australia; Everard Range, &c.
7442. DARWINI, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 808.
N. Territory of S. Aust.
7443. RIVERINÆ, Sloane, l.c. ix. 1894, p. 455.
N.S. Wales; Urana, Tamworth, &c.
- Sp. 656. G. ADELAIDÆ, Casteln. = *Microsaurus insularis*, Bates (sp. 706); Blackb., l.c. p. 88.

DIAPHOROMERUS, Chaudoir.

7444. FROGGATTI, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 468.
N.W. Aust.; King's Sound.
7445. LATICOLLIS, Macl., l.c. p. 468.
N.W. Aust.; King's Sound.
7446. MULTIPUNCTATUS, Macl., l.c. p. 467.
N.W. Aust.; King's Sound.
7447. NIGRANS, Macl., l.c. p. 470.
N.W. Aust.; King's Sound.
7448. OPACUS, Macl., l.c. p. 469.
N.W. Aust.; King's Sound.
7449. POLITUS, Macl., l.c. p. 465.
N.W. Aust.; King's Sound.
7450. PORCATULUS, Macl., l.c. p. 469.
N.W. Aust.; King's Sound.

7451. *SERICIPENNIS*, Macl., l.c. p. 470.

N.W. Aust.; King's Sound.

7452. *SEXPUNCTATUS*, Macl., l.c. p. 466.

N.W. Aust.; King's Sound.

7453. *SULCATULUS*, Macl., l.c. p. 467.

N.W. Aust.; King's Sound.

7454. *VICTORIENSIS*, Blackb., l.c. v. 1890, p. 777.

Mountains of Victoria.

Sp. 678. *D. (HARPALUS) DEYROLLEI*, Casteln.; Blackb.,
Trans. Roy. Soc. S. Aust. x. 1886-7, p. 190; Proc. Linn.
Soc. N.S. Wales, ser. 2, iii. 1888, p. 1387.

S. Australia; Port Lincoln, &c.

HYPHARPAX, W. S. Macleay.

455. *BOISDUVALLI*, Casteln., Trans. Roy. Soc. Vict. viii. p. 196;
Chaud., Ann. Mus. Civ. Genov. xii. 1878, p. 487; Blackb.,
Trans. Roy. Soc. S. Aust. 1887, p. 184.

W. Australia.

7456. *INORNATUS*, Germ., Linn. Ent. iii. 1848, p. 1690; Blackb.,
l.c. p. 183.

S. Australia.

7457. *OBSOLETUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2,
vii. 1892, p. 84.

W. Australia; Yilgarn.

7458. *OPACIPENNIS*, Macl., l.c. iii. 1888, p. 471.

N.W. Aust.; King's Sound.

7459. *SLOANEI*, Blackb., Trans. Roy. Soc. S. Aust. xiv. 1891, p. 95.

N.S. Wales; near Mulwala.

7460. *VARUS*, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888,
p. 471.

N.W. Aust.; King's Sound.



7461. *VILIS*, Blackb., l.c. v. 1890, p. 777.

S. Australia.

Sp. 675. *H. (HARPALUS) AUSTRALIS*, Dej.; Blackb., l.c. vii. 1892, p. 83.

N.S. Wales; near Sydney.

Sp. 678. *H. DEYROLLEI*, Casteln.; Blackb., l.c. iii. 1888, p. 1387.

THENAROTES, H. W. Bates.

7462. *AUSTRALIS*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 184.

S. Australia; Port Lincoln, &c.

7463. *DISCOIDALIS*, Blackb., l.c. p. 184; Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 780.

S. Australia.

var.? *NIGRICORNIS*, Blackb., l.c. p. 788.

Mountains of Victoria.

7464. *METALLICUS*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 185.

S. Australia; Adelaide.

Sp. 936. *T. (TRECHUS) ATRICEPS*, MacI.; Blackb., l.c. xix. 1895, p. 28.

NOTOPHILUS, Blackburn.

7465. *GRACILIS*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 186.

S. Australia; Port Lincoln.

7466. *LÆTUS*, Blackb., l.c. p. 187.

S. Australia; Adelaide, Sedan.

7467. *MONTANUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 780.

Mountains of Victoria.

7468. *NIGER*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 186.

S. Australia; Port Lincoln.

7469. *PALUSTRIS*, Blackb., l.c. p. 188.

Murray River.

7470. *PARVUS*, Blackb., l.c. p. 187.

S. Australia.

LECANOMERUS, Chaudoir.

7471. *FLAVOCINCTUS*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 188; Proc. Linn. Soc. N.S. Wales, ser. 2, iv. 1889, p. 1250.

S. Australia; Port Lincoln.

7472. *LINDI*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 189.

S. Australia; Port Lincoln.

7473. *MAJOR*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vi. 1891, p. 479.

N.S. Wales; near Burrawang.

7474. *NITIDUS*, Blackb., l.c. v. 1890, p. 779.

Mountains of Victoria.

7475. *OBSCURUS*, Blackb., Trans. Roy. Soc. S. Aust. x. 1887, p. 189.

S. Australia; near Adelaide.

7476. *STRIATUS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vi. 1891, p. 479.

N.S. Wales; near Burrawang.

HAPLANER, Chaudoir.

7477. *ASSIMILIS*, MacL., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 473.

N.W. Aust.; King's Sound.

7478. *MARGINATUS*, MacL., l.c. p. 472.

N.W. Aust.; King's Sound.

7479. PUNCTICOLLIS, Macl., l.c. p. 473.

N.W. Aust.; King's Sound.

7480. RECTICOLLIS, Macl., l.c. p. 472.

N.W. Aust.; King's Sound.

7481. SUBSERICEUS, Macl., l.c. p. 473.

N.W. Aust.; King's Sound.

ACUPALPUS, Latreille.

7482. BIMACULATUS, Macl., Proc. Linn. Soc. N.S. Wales, ser. 2, iii. 1888, p. 475.

N.W. Aust.; King's Sound.

7483. MORGANENSIS, Blackb., l.c. v. 1890, p. 556.

S. Australia?

7484. ORNATUS, Macl., l.c. iii. 1888, p. 475.

N.W. Aust.; King's Sound.

7485. QUADRIMACULATUS, Macl., l.c. p. 474.

N.W. Aust.; King's Sound.

CYCLOTHORAX, Macleay.

Sp. 923. C. (PLATYNUS) AMBIGUUS, Erichs.; Sloane. Proc. Linn. Soc. N.S. Wales, ser. 2, ix. 1894, p. 447.

7486. CURTUS, Sloane, l.c. ix. 1894, p. 448.

Victoria; Bendigo.

7487. EYRENSIS, Blackb., l.c. vi. 1892, p. 480.

S. Australia; basin of Lake Eyre.

7488. FORTIS, Blackb., l.c. iii. 1888, p. 1390.

S. Australia.

7489. OBSOLETUS, Blackb., l.c. p. 1389.

S. Australia; Port Lincoln.

7490. PERYPHOIDES, Blackb., l.c. p. 1392.

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7491. PUNCTATUS, Sloane, l.c. ix. 1894, p. 449.

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7492. CÆRULEUS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890, p. 555.

N. Territory of S. Australia.

7493. SUTURALIS, MacL., l.c. iii. 1888, p. 470.

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7494. CRENULATUS, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, iv. 1889, p. 726.

N. Territory of S. Aust.

7495. MACLEAYI, Blackb.

flavipes, MacL. (name preoc.), l.c. iii. 1888, p. 480.

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7496. QUADRATIPENNIS, MacL., l.c. p. 480.

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7497. SIMPLEX, Blackb., l.c. iv. 1889, p. 726.

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7499. *BREVIS*, Blackb., Proc. Linn. Soc. N.S. Wales, ser. 2, vii. 1892, p. 87.

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7500. *DISCOIDALIS*, Blackb., l.c. v. 1890, p. 782.

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7502. *SINUATUS*, Blackb., l.c. vii. 1892, p. 87.

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7515. FORTIS, Sloane, Proc. Linn. Soc. N.S. Wales, ser. 2, v. 1890,
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- Sp. 201. *C. UNICOLOR*, Hope, Ann. Nat. Hist. ix. 1842, p. 426; Chaud., Ann. Mus. Civ. Genov. vi. 1874, p. 574 : Bull. Mosc. liii. 1878, p. 35.

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Issued November 18, 1895.

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PART THE SECOND.

Containing the Papers read at the Meetings
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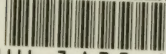
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